MOBILE SATELLITE SERVICES - A SURVEY OF BUSINESS NEEDS

by

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Mobile Satellite Services - A survey of Business Needs.

Thesis directed by Stanley E. Bush

Abstract: This thesis has a dual purpose - conceptualizing and understanding the international business traveler's communication requirements by the use of a survey and selection of a mobile satellite system that satisfy those requirements. Chapter V incorporates an in depth analysis of the respondent's answers to survey questions and graphing them with frequency distribution histograms. Chapter VI concludes with a selection of the most likely MSS manufacturer who appears to satisfy those communication requirements discovered in the previous chapter.

Following a general introduction in Chapter I, the current climate of mobile satellite system (MSS) providers is discussed in Chapter II. Chapter III assesses the implication of launch vehicles as it pertains to the political, technical, and financial aspects of MSS manufacturers and users. Special attention is provided, when possible, between the political environment and its relationship with forefront technology. In chapter IV, the procedure that was used to create the survey and its research methodology is shown. Graphs and charts are used, where appropriate, for the purpose of clarity and readability.

DEDICATION

I would like to dedicate this thesis to my wonderful wife Koula, and our three children - Joseph, Irene, and Steven. Without their unstinting love and continuous support any success, either real or perceived, would be hollow and empty.

ACKNOWLEDGMENT

I would like to acknowledge my sincere appreciation to Stanley Bush who served as the Thesis Chairman, and Gerald Mitchell together with Richard Chandler who also served on the Thesis Committee. I would be remiss not to acknowledge the generous financial support of the US Army in which I proudly serve.

Because submission of this thesis is during the same semester as the 1992 presidential elections and Christopher Columbus's 500th anniversary, a special recognition seems appropriate. This gratitude transcends past the men and women in the military who are serving today to those who have served in the past. Especially, from those breathtaking missions of heroism when B-17's and their crew conducted strategic daylight bombings over occupied Europe to today when Airborne and Special Forces Teams are ready to deploy in a moments notice anywhere in the World. I trust those who serve this country in the future will draw strength and courage from this remarkable lineage from which they decend.

PREFACE

Although the concept and implementation of Mobile Satellite Communication (MSS) systems are new for today, The Bible has made many references to a global communication system. If we can't imagine life without a radio, TV, or telephone, imagine what the scribes, pharisees, and lawyers thought when reading the following passages:

> *For the earth shall be filled with the knowledge of the glory of the Lord, as the waters cover the sea.*
> (Habakkuk 2: 14)

> *And the gospel must first be published among all nations.*
> (Mark 13: 10)

> *And this gospel of the kingdom shall be preached in all the world for a witness unto all nations ; and then shall the end come.*
> (Matthew 24: 14)

The scribes of ancient times must have wondered just how many quills, how much ink, and how much time it would take to complete such a task. I doubt that it's any easier today.

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CHARTS AND DIAGRAMS

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CHAPTER I

INTRODUCTION

Thesis Statement

This thesis will explore the various technologies and government forces that affect personal global satellite communication system, and will investigate:

1. Future technologies which will be available for a personal global communication system.

2. How politics and technology are inextricably linked together for employment of a personal mobile communication system.

3. The results of a mail out survey to large companies and select a single service provider that will have the greatest opportunity for success based on the derived analysis.

The existing possibilities in the market today will be compared with the results of a survey mailed to 120 fortune 1000 companies in the twenty-four industry groups in the US.

Today, the impact of the information explosion that results in social and economic changes is often compared to the industrial revolution of the 18th and 19th century. Vendors with competing technologies are vying for shares of

what they perceive as a huge untapped marketplace for their wares.

Most recently, agreements reached at the World Administrative Radio Conference (WARC) in Spain have established preliminary frequencies for mobile satellite communication systems available to many different manufacturers. "Over 150 companies have applied to the Federal Communications Commission for licenses to experiment with [satellite] technology, and many also plan to offer data communication services too"1. A dynamic tension exists among four global trends that indicate a worldwide communication network is both economically affordable and politically encouraging to even the poorest of nations. In light of this, the four key areas of interest are infrastructure development, privatization, deregulation, and technology. The information provided below expands on the four areas of global concern.

Developing Infrastructure- The continuing rise in the growing population and increasing economic interdependencies have resulted in a growing global urbanization. The fall of communism and the recent emergence of several new independent countries, whose borders change daily, have greatly increased the opportunities for growth. Thus, time is a crucial factor in assimilating these new nations into a worldwide economic community. "China and the Indian subcontinent are home to nearly half of the world's population, yet they have fewer

than two telephone lines per 100 people"[2]. In Poland, over two million people are waiting for phone service and in Mexico the waiting list is over one million names [3]. Thus, compatibility with the worldwide communication system is as crucial to a country as deep water ports are for international commerce and trade. Virtually all developed or developing countries are either updating, installing, or altering their telecommunications infrastructure.

Privatization-So far, over 24 countries in the Pacific Rim, Latin America, and Europe have created or have plans to create their own private telecommunications industry by 1995 with little if any governmental control [4].

Deregulation-The breakup of phone monopolies and the evolution of cutthroat competition in the local and long distance services is creating enormous niche markets all over the world. "The price per minute of international services has fallen, usage has increased, driving total revenue for international telephone services upward"[5].

New Technologies- New digital technologies are finding increased applications by incorporating and interfacing with worldwide communications networks. DAB, voice mail, videoconferencing, and on-line information services have provided a brand new type of industry. "Large service industries such as financial services, airline reservation systems, health care, retail sales, and education maintain the global shift from material-intense to information-intense industries"[6]. The advent of digital switches and fiber optic

cables have multiplied the power of telecommunication systems available to the public and into our homes and offices. Fiber to home trials are already underway in the US., Japan, and Europe. AT&T is expected to release its new low-cost videophone July 1992 and retail for about $1500.

BIBLIOGRAPHY ENDNOTES

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2. Minella, David. G. T. Global Financial Services Prospectus January 27, 1992, page 8.

3. Ibid, page 3.

4. Ibid, page 9.

5. Federal Communication Reports on International Revenues. Space Commerce; Satellite Communications. January 1991, chapter 42.

6. Minella, David. G. T. Global Finanial Services Prospectus January 27, 1992, page 14.

CHAPTER II

THE PLAYERS

The increased business demand for satellite service is responsible for the recent growth in space commerce and its related industries. Nevertheless, some communication professionals believe that space commerce can be interpreted to mean, to a large degree, space communication. Although most communication manufacturers have had some space experience, especially with the military, the competition for commercial satellite communication systems is expected to be intense. The world's two largest defense purchasers, the United States and the new Commonwealth of Independent States in the former Soviet Union, are downsizing so rapidly that high-tech hardware manufacturers are racing to fill the void with new smallsat applications.

The major participants fighting for product position of mobile satellite communication systems may be determined, in part, by the outcome of the World Administrative Radio Conference (WARC) that concluded in February of 1992 in Torremolinos, Spain. This latest conference assigned frequency allocation for non-geosynchronous orbiting

satellites, or most commonly dubbed LEO (low earth orbit). "Worldwide, primary allocation for non-geosatellites (LEOs) at the WARC is in the bandwidths of 1610-1626.5 MHz and 2483.5-2520 Mhz"[7]. Additionally, many organizations are holding their own meetings as well. In March 1992, these organizations presented over 150 papers at the 14th annual International Communication Satellite System Conference and Exhibit. This exhibit, sponsored by the American Institute of Aeronautics and Astronautics, met to discuss North America's participation in LEOs, medium earth orbiting (MEOs), and highly elliptical orbit (HEOs) satellite systems. Proponents of non-geo satellite systems claim that the systems are both more efficient and more cost effective. In addition, these systems possess greater enhancement capabilities in a constellation network above the earth's surface. A statement by a prominent consultant, Walter Morgan, indicated that there is plenty of opportunity for growth in the personal, portable and mobile communication networks via satellite. However, he later became concerned about the recent WARC conference because it left more questions unanswered than it resolved prior to the conference. Also, Rene' Collette of the European Space Agency (ESA) said, "at first glance WARC appears clear, but will be difficult to interpret"[8]. Although Collette addressed his concerns about European involvement, the big winners of the WARC conference appear to be the little LEOs (smallsats). He also believes that the downlink to

earth may become a larger problem than others thought it would be because of the limited frequency spectrum.

The point Collette stressed would be the single most significant issue to address and resolve, from ESAs perspective, is the political issue. LEOs, MEOs and HEOs, regardless of the satellite orbit, have significant implications for countries who may wish to use them. But this would prevent them from creating any net worth or income by using another country's system. "A good way to begin implementing mobile services would be through INMARSAT, which already has a commercial base throughout the world and, presumably, has faced both scientific and political hurdles" 9.

In addition, there are the justifiable concerns from other parties that the allocated frequency spectrum cannot be shared by several vendors simultaneously. "The WARC resolution noted that there are no standards for the coordination, sharing, and operation of such systems. The WARC delegates asked the International Telecommunication Union's technical groups to undertake studies on LEO satellites" 10. But the delegates knowingly admitted, "that only a very limited number of LEO systems offering worldwide coverage can coexist in one frequency band" 11.

As illustrated below, LEOs offer both advantages and disadvantages as shown below:

Advantages: *Less transmission delay and 'echo'
*Less power required to receive and transmit
*Ability for smaller and lighter satellites
*Use less powerful earth stations
*Smaller launch vehicles that cost less

Disadvantages: *Smaller earth area coverage
*Less traditional technology
*More maintenance for orbit
*Usually increased hardware expenses
*Doppler effect

Satellites in elliptical orbits do not maintain a permanent position relative to the earth's surface (sometimes called the sub satellite point) as geosynchronous orbits do, but cross over specific areas at a predictable period. When at the apogee in a parabolic orbit (when the satellite is farthest from the earth's surface) a specific area of coverage can be increased. And since orbit is initiated at the perigee (when the satellite is closest to the earth's surface) the launch costs can possibly be reduced. Great attention is given to how much maneuvering in space is required because of fuel weight considerations prior to launch.

LICENSE AGREEMENTS

Filing for radio frequency spectrum is only the first step in a long journey to implementing a communication satellite network. An interested firm must also petition and receive an authorization license from every country in which they plan to operate the satellite system. To date, Motorola has refused to disclose its international relationship agreements or prospective partners, but there are indications that it may do so sometime in fall 1992. On the other hand, INMARSAT is a consortium of over 60 countries and is believed to use its existing influence and long-standing relationships with member nations to gain support.

Consultant Sylvia Ospina in Washington D. C. indicates that so far, each government associated with INMARSAT receives revenues from their host national carriers that sell INMARSAT services inside their respective countries. The revenues are then reinvested in services which the government desires. Ospina asked, "What advantage is it for them to let a foreign company come in and take over their revenues?"[12].

Motorola's Iridium, INMARSAT, and Globalstar have the most comprehensive and detailed plans for a personal mobile satellite systems, because of their historical makeup and previous manufacturing experience. But many other small US manufacturers are also trying to enter the new market with an entrepreneurial spirit to penetrate niche markets as a custom service provider.

In April of 1992, two months after the WARC conference, the FCC granted an experimental license to two competing LEO satellite system vendors: Orbital Communication (Orbcom) and Starsys Global Positioning. They both plan to manufacture 2-way mobile satellite communication systems in the US for low powered portable terminals resembling cellular telephones. The FCC can provide for expeditious application approval if the company can prove the technology is new and innovative by the requesting supplier.

The FCC calls this process Pioneer's Preference, and it openly promotes favoritism for proposals that request an operation license if it can demonstrate "first time and new spectrum efficient technologies"[13]. Unfortunately, in this specific case, the FCC declined Orbcom's request for Pioneer's Preference because its technologies were "relatively routine design features that most new LEO satellite licensees would be expected to accomplish"[14]. Many additional companies have recently applied to the FCC for Pioneer's Preference statement for their versions of LEO systems. The proposals include Constellation Communications Inc., Ellipsat Corp., Loral/Qualcom Satellite Services Inc., Motorola Satellite Communications Inc., TRW Inc., Crescomm Transmission Services Inc. and Celsat Inc. Of course, not all of the company requests to the FCC are for the same services or competing for the same customers. But a great spectrum battle is guaranteed in light of over 280 microsatellite applications being filed with the FCC for LEO and MEO satellites. Design

requirements require the following number of satellites for each system: Iridium-77, Aries-48, Loral Globalstar-48, Leosat-24, Ellipsat-24, Orbcomm-20, TRW's Odyssey-12, and VITA with 3. In light of current defense budgetary reduction programs, the most prominent contractors are looking at the commercial marketplace to fill the void.

Specifically, Crescom "is seeking to permit digital, shipboard earth stations to communicate with fixed and temporary-fixed satellite earth stations from locations in ocean, sea, and coastal areas"15.

Celsat, based in San Diego, California, is proposing a hybrid-cellular venture to offer a combination satellite and ground-based cellular interface system for phone, facsimile, digital data, position determination systems, and video services.

Orbcomm said it will develop, construct, and operate two LEO satellite systems as part of a first phase attempt of a communication system in the U. S. by 1993 and complete it by 1994. This will permit testing and consumer demonstration of services provided as well as revenue producing opportunities for 2-way message transmission and radiodetermation services, presumably with a large American automobile manufacturer. Beating Starsys to the marketplace before their 1995 product introduction have left ORBCOMM "to reevaluate our plans"16. But each company said it plans to introduce its services in the US first, then perhaps expand into other countries where possible. Starsys hosted a

conference on April 7-8 of 1992 with leading electronic manufacturers to discuss some options for developing portable communication terminals.

But as indicated before, the only real contenders to date that offer the worldwide personal communication services to both industry and consumers are Motorola's Iridium, INMARSAT's Project 21, and Globalstar. Industry experts have noted that the "demand for terrestrial cellular telephone service has far outpaced analysts' projections. Recent estimates stand at 100 million subscribers by the year 2000"[17].

Iridium

The Iridium system proposed by Motorola, Inc. through its subsidiary Motorola Satellite Communications, Inc., will provide for the ability of anyone, whether on land, sea or in an airplane, to communicate with anyone else in the world when fully operational in 1997. The name Iridium is coined after its atomic element counterpart because of the number of electrons circling the atom nucleus, 77. These 77 small "smart" satellites make up the backbone of the Iridium system whereby each have the ability to communicate with each other, a terminal on the ground, or a terrestrial gateway station. This satellite constellation of digital communications will use primarily small portable terminals linked to a network of LEO satellites to provide point-to-point communications to users located anywhere in the world. This

will require a combination of technologies in two areas-space communication systems and cellular communication systems. In these systems, hand-offs occur without any noticeable effect to the users. The LEOs will allow lower power levels from the earth's transmit station because of its proximity to the satellite, thereby reducing the portable unit's weight and maintaining an acceptable battery life for normal operation.

Supporting technologies still under research and development are crucial to the overall success of the complete system. The design and size of the satellites themselves, phased array antenna systems, microcircuitry of electrical components, and advanced processing of newly designed communication distributed network architecture are some of the requirements to be resolved. Implicit of the desire for point-to-point independent performance is on board digital processing and automatic switching features to be performed in orbit. This may also include on-board billing and accounting functions in the future if processors allow, which are traditionally performed at a central earth management facility. "Principles of cellular diversity are used to provide continuous line-of-sight coverage from and to virtually any point on the earth's surface. Spot beams provide substantial and unprecedented frequency reuse- more than 5 times in the U.S. alone"[18] "and more than 200 times worldwide"[22]. This all occurs 413 nautical miles above the surface of the earth. See figure 2-1 and 2-2 below.

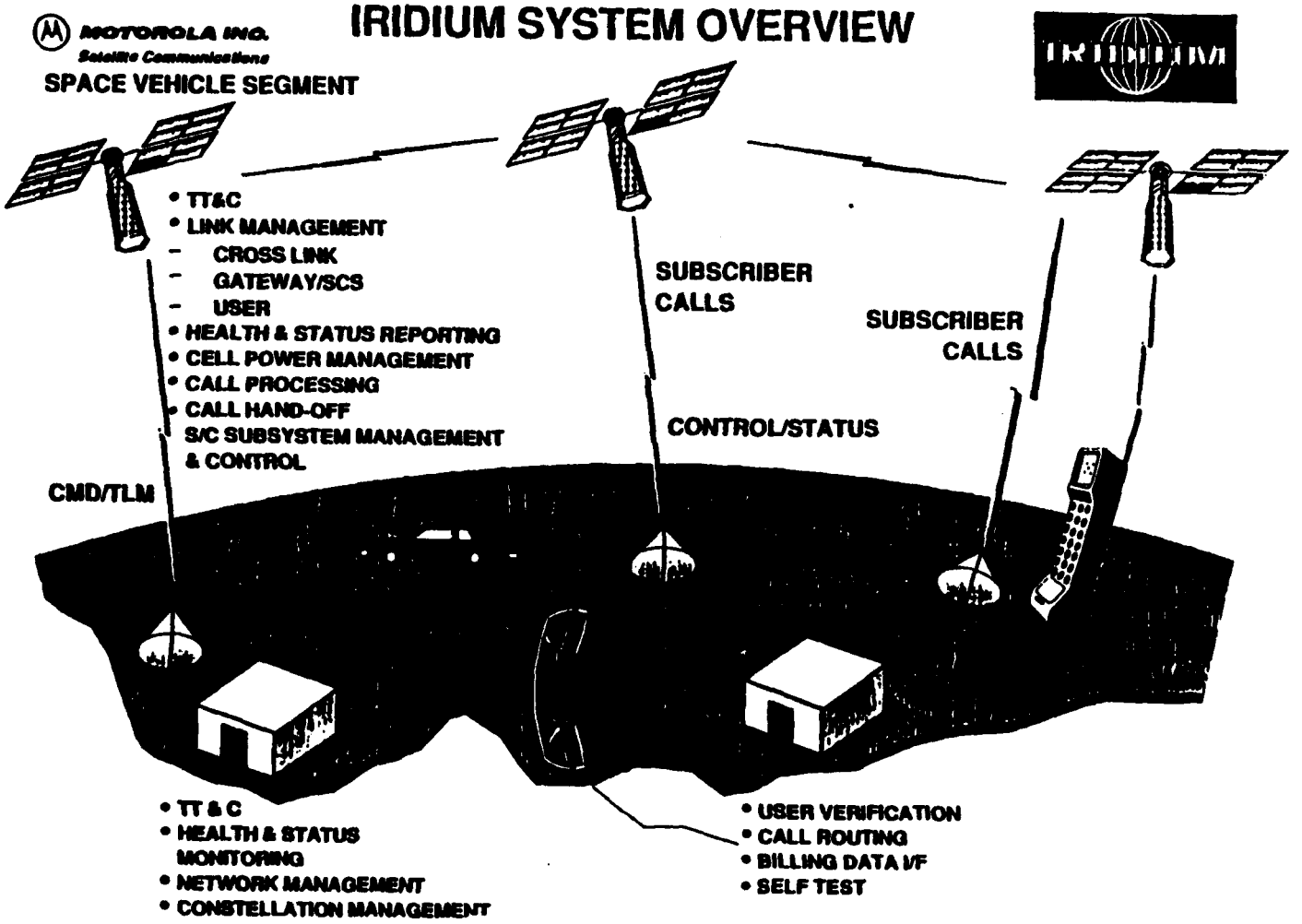
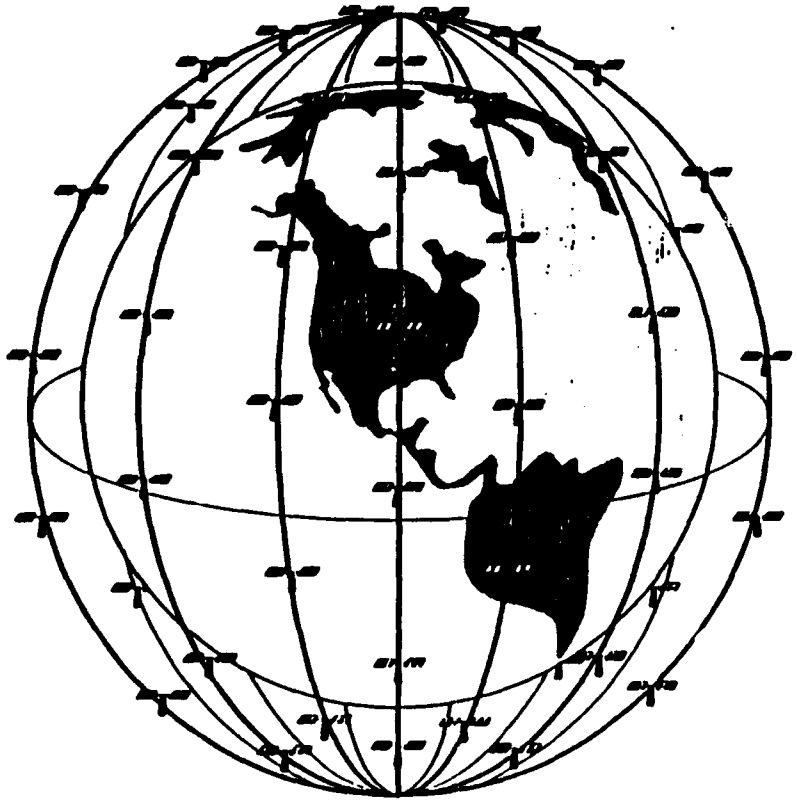
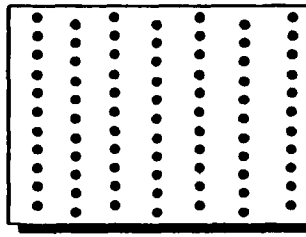


FIGURE 2-1
Compliments of Motorola

MOTOROLA IRIDIUM SATELLITE SYSTEM

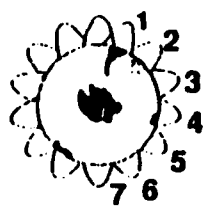


SATELLITES



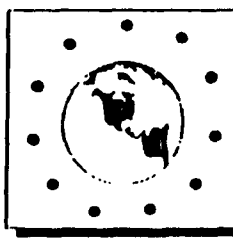
THE SYSTEM REQUIRES SEVENTY-SEVEN... SATELLITES

POLAR VIEW



POSITIONED IN SEVEN ORBITAL PLANES..

EQUATORIAL VIEW



CONTAINING ELEVEN SATELLITES PER PLANE.

FIGURE 2-2
Compliments of Motorola

In its application request to the FCC, Motorola requested approval authority to use as the uplink the 1610-1626.5 MHz band. They openly acknowledge this 16.5 MHz bandwidth will only satisfy the projected immediate demand for services through the latter part of this decade. In its application to the FCC Motorola also stated that, "ultimately, Iridium will need to access up to 100 MHz of L-band spectrum worldwide to meet the projected demand into the next century"[19] and in addition "will need 200 MHz of spectrum in the Ka-band for its gateway feeder links and 200 MHz for the intersatellite links"[20].

With Iridium, all of the transponder capacity will be provided to a licensed and authorized representative not publicly identified to date. It should also be added that Iridium, because of its relatively limited traffic capacity, is not designed to compete with existing landline and terrestrial based cellular mobile systems-but augmentation and enhancement of the compatible infrastructure. Conversely Iridium plans to target markets that are currently lacking in cellular systems or landline networks. Areas of specific concern and interest are sparsely populated locations and in developing, as well as developed countries, where the telephone service is not of sufficient type and quality to handle the traffic expected of a modern day business. The full range of services to customers such as paging, messaging,

voice, facsimile, and data transport may indeed meet, "the expected six million subscribers"[21].

Because of the innovations in Iridium's technology, the FCC did grant the Pioneer's Preference award for its accomplishment and significant technological achievement. FCC's Chairman Sikes referred to Motorola's Iridium system as "just such a new and innovative service worthy of encouragement by the Commission [and] the need to develop an international regulatory framework that is not just conducive, but hospitable to innovation and technological advances and the FCC should tilt in that direction"[23]. This endorsement sends a clear message to all of its competitors in the field.

Gateways, or ground stations, in other countries will provide the connective link between Motorola's satellite and the public switch telephone network. This will allow communication between the satellite constellation and any other phone, fax, or data transmission device connected to the host country's network.

It is not clear if the introduction for various services will occur at once or brought on separately. However, Motorola does plan to provide five types of services operated by a family of related terminals as shown below:

*Geopositioning and two-way messaging- The system will offer a RDSS-type unit to be used for automatic location reporting and two-way messaging.

*Digital voice transmission- Iridium is expected to deliver high-quality 4800 bps voice communication over handheld, portable or vehicular mounted terminals.

*Facsimile -two types of mobile fax's are planned. One type is a stand alone and the other will be compatible with the Iridium phone if an adapter is used.

*Data transmission-A 2400 bps modem compatible with the iridium handset terminal is planned

*Global paging- An alphanumeric pager for instantaneous global paging is under development. This device is intended for domestic and international areas where adequate quality telephone service is available for a timely response back to the caller.

Because the density of traffic is admittedly lower than a conventional communication system, the initial price and airtime is obviously going to be higher, at least in the beginning. "The initial production price for the basic handheld telephone set is expected to be at about the $3000 range. This may drop to less than $1000 in a few years as volume increases and more customers subscribe to the system"[24]. Of course, "the service cost will probably vary depending on the country and the time of day"[25]. A nominal price by company representatives estimate a toll rate of $3.00 per minute for those outgoing calls which are not distance dependent to the satellite, and a subscriber fee of approximately $50 per month per user.

The Iridium subscriber base for intermediate planning purposes is for the year 2001 and 2006, that would be 5 and 10 years after the introduction of the services. The total "worldwide number of subscribers is expected to exceed 1.8 billion in 2001 and 2.8 billion in 2006"[26]. For all types of services available, the number of "Iridium applications in the US alone is over 30 million"[27] and is anticipated to become even greater.

Motorola expects that the long haul trucking business will consume "approximately 25% of the total subscriber base"[28] for radio determination and related two way message service. "Global paging would also account for 25 percent of the subscribers. The remaining 50 percent of Iridium subscribers would be split among other service applications"[29], such as business aircraft, mining and drilling activities, and other similar applications. Fortunately, Motorola anticipates that "foreign business travelers in developed countries are expected to be the main users of Iridium's global paging service"[30] which generate almost "60 percent of the 50,000 US business people traveling"[31] outside America. Finally, "10 million commercial air travelers would also use the system's telephone, data, and RDSS services ... and supplied by authorized service providers"[32]. Uses other than aviation that were previously illustrated are emergency or distress situations such as ambulatory uses, handicapped customization and government backup of communications that could provide a disaster recovery alternative should the

need arise. Other potential uses include recreational vehicles, pleasure boats, and general aviation.

Only a small amount of engineering detail has been released, but plans do call for a somewhat open architecture design that would allow a significant amount of international participation in the development and manufacture of the Iridium system. It is generally agreed that neglecting the international community in the design process could spell disaster during the implementation and deployment phase due to the complex interrelationships which exists in the markets today.

Presently an international consortium will jointly own and operate the proposed system and its future success is crucial if Motorola is to beat out its major rival, INMARSAT, who has been dealing in this environment for three decades.

Another obstacle is the standards issue. "Today, there is no agreement regarding frequencies and user's technologies for the cellular digital technology expected to replace analog ground based systems during the present decade"[33]. This will force the consortium participants to create and enforce technical as well as many other standards that future member nations may not want. "Japan, Europe, the US, and Scandinavia will have differing cellular digital technologies standards"[34] which would result in a system, if successful, would more likely represent a hybrid system than a US system.

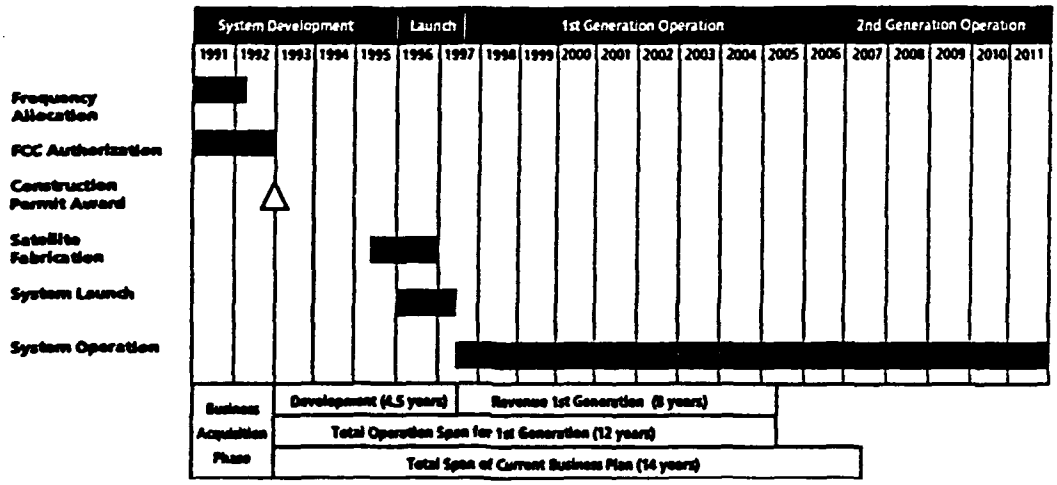
GLOBALSTAR

The Loral Aerospace Corporation and Qualcom, Inc. filed an application with the FCC to form a new corporation for its version of worldwide satellite communication services on June 3, 1991. Qualcom developed and operates a satellite based trucking communication service called OmniTRACS and uses Code Division Multiple Access (CDMA). It gives real-time position locating services and messaging services between truck fleets operation center and its vehicles. With its significant patented technology in CDMA applications, it has developed a unique position in the current marketplace which may propel it ahead of other services available. By using its version of a 48 satellite constellation as opposed to Iridium's 77, Globalstar can provide equal amount of global coverage because of the greater distance above the earth's surface. These low earth orbit satellites will operate through earth based gateways and incorporate existing terrestrial networks currently in operation, thereby generating income from local, long distance, and cellular networks at a more competitive rate. This is because it is assumed that by utilizing the existing infrastructure it will bring the total system cost down to significantly lower rates than space based satellite switching systems inside the satellites. Another feature is its interoperability with existing cellular and future Personal Communication Networks. It is very likely that CDMA will become widely accepted as the new multiple

access technique for the future. Because of the coding scheme, it is estimated that twenty to fifty times more users can share the same spectrum bandwidth. Should this become the new standard for the future, Globalstar may be in a tremendous position to exploit the only satellite based CDMA satellite system being planned. This also has the inherent quality of better security. One way to be more secure is to design a sophisticated database management system that permits only authorized users to gain access to the space segment. This would prevent fraud and theft of airtime that currently exceeds billions of dollars in cellular systems today. By utilizing the Public Switched Telephone Network, Globalstar can maximize service reliability due to the built in redundancy and disaster recovery plans already in place. Because the general public is constantly reinvesting dollars in this terrestrial system, the PSTN network is constantly improving, thus, improving in part the Globalstar system. This design compliments the long distance carrier rather than competes, so it does not become a bypass system. Additionally, this will result in the sharing of revenues with the carriers and will keep gateway construstion costs low and not too complex. This increased revenue and profit to the carriers may even subsidize the industry and keep long distance terrestial calls lower than it would otherwise be. Operating as a non-common carrier grants them the opportunity to concentrate on the designing, building, and testing just the satellite portion of the network and sell the

capacity to the carriers themselves. Sales would either be in bulk call minutes or on a demand basis. This service will ultimately culminate in hand held digital telephones for voice, fax, or data anywhere in the world. Other services being planned are Radio Determination Satellite Services (RDSS) that gives the uses position location and global paging and messaging services. All of these services are billed from the gateway or communications carrier in the users area of use rather than corporate headquarters. Because of the orbiting characteristics, each subscriber is constantly within range of three to four satellites which allow for automatic self renovation over peak loading periods. Soft handover of conversation by the users handset allowes for automatic uninterrupted service through a seamless network.

The proposed launch pattern is suggested to consist of six launches of eight satellites each, for a total of 48 deployed worldwide at an altitude of 750 nautical miles. With simple features such as no on- board processing, exploitation of the common carriers network, fraud protection, compatibility with the PSTN, and maximization of the frequency band, Globalstar appears better poised than Iridium for personal mobile satellite communications. See figures 2-3 and 2-4 below.



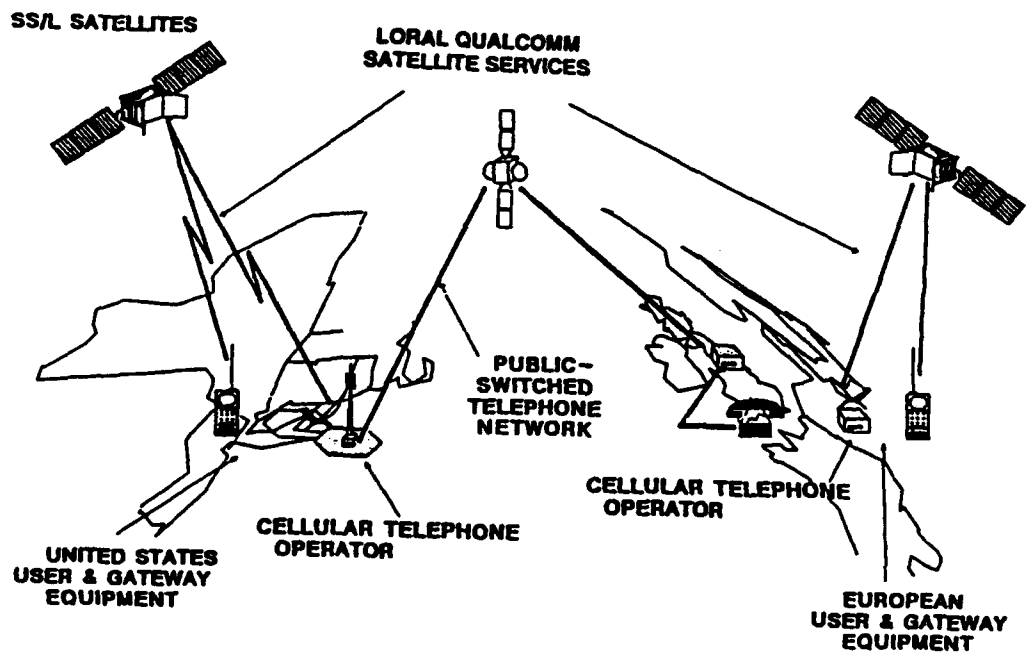
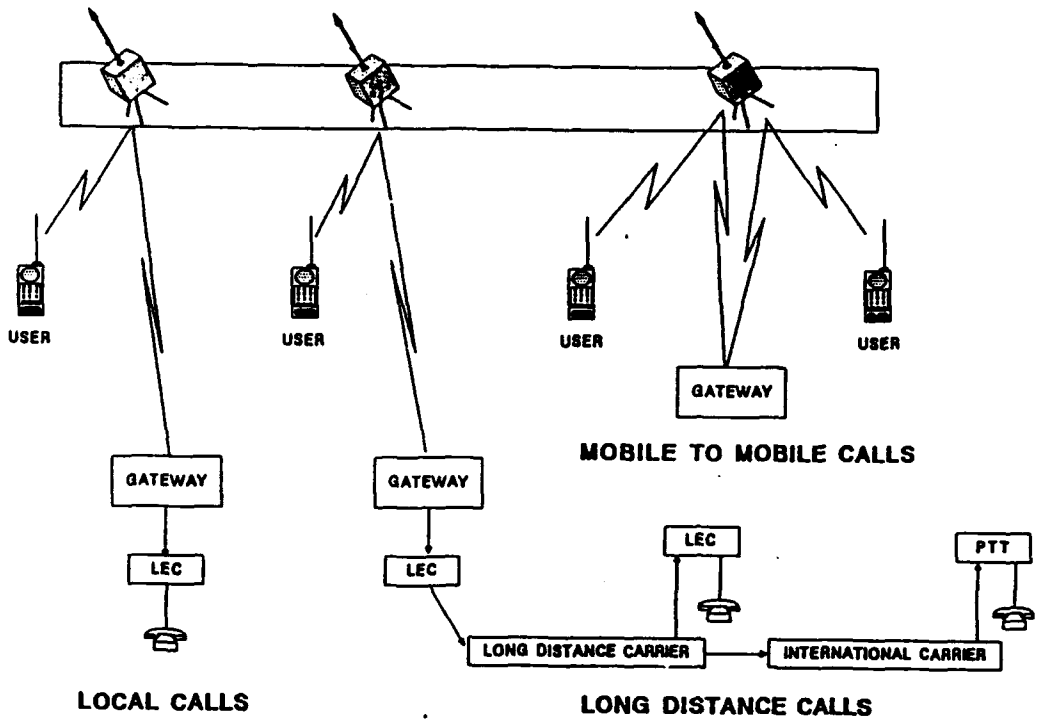


Figure 2-3
Courtesy of Globalstar

SYSTEM OPERATION WITH EXISTING NETWORKS



SYSTEM OPERATION IN LOCAL OR ROAMING MODE

- USER MAKING OR RECEIVING CALLS IN HIS HOME SERVICE AREA INCURS NO LONG DISTANCE CALLS
- USER ROAMING AWAY FROM HIS HOME SERVICE AREA MAY OR MAY NOT INCUR LONG DISTANCE CHARGE DEPENDING ON HIS CALL DESTINATION

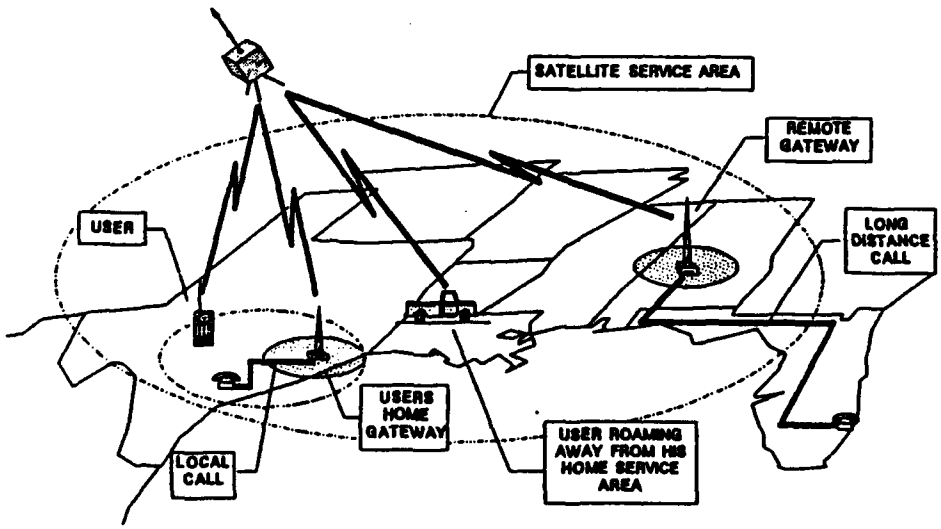


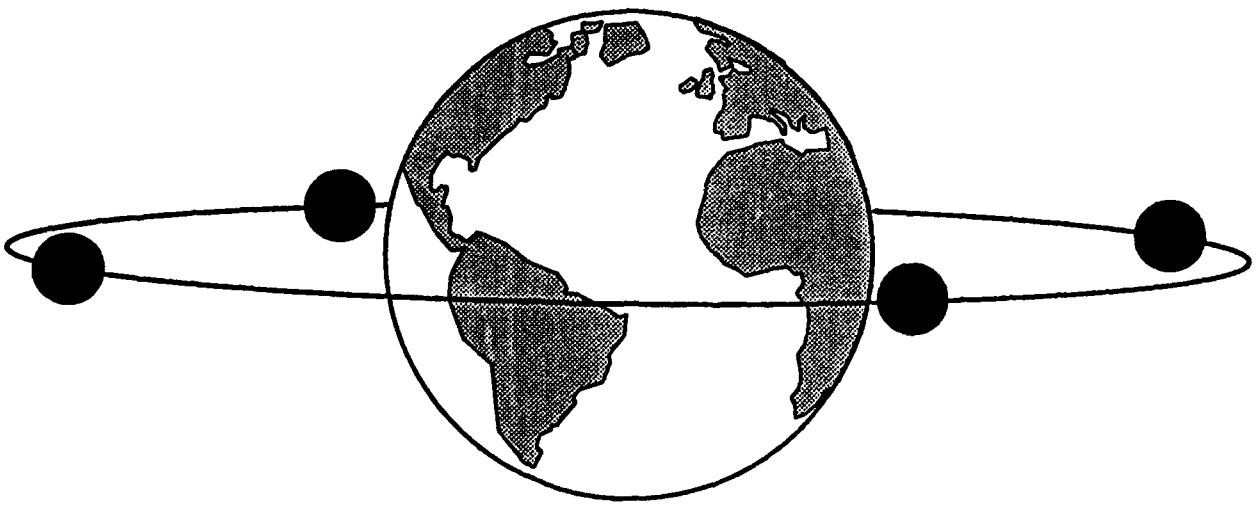
Figure 2-4
Courtesy of Globalstar

INMARSAT

INMARSAT, short for International Maritime Satellite Organization, is a London based consortium founded in 1979 with the initial aim to provide communication services to the maritime industry. Today with its recent launch of its fourth maritime satellite and a long-standing 64 member international community, INMARSAT can provide complete maritime communication coverage "and is the sole global provider of mobile satellite communications for commercial, distress, and safety applications at sea, in air, and on land"[35]. Thus far, INMARSAT has disclosed three possible satellite orbital systems mobile satellite communications system as shown in figures 2-5, 2-6, and 2-7 below.

The Inmarsat Evolution:

Possible future systems



GEOSTATIONARY ORBIT

Figure 2-5
Courtesy of INMARSAT

The Inmarsat Evolution:

Possible future systems

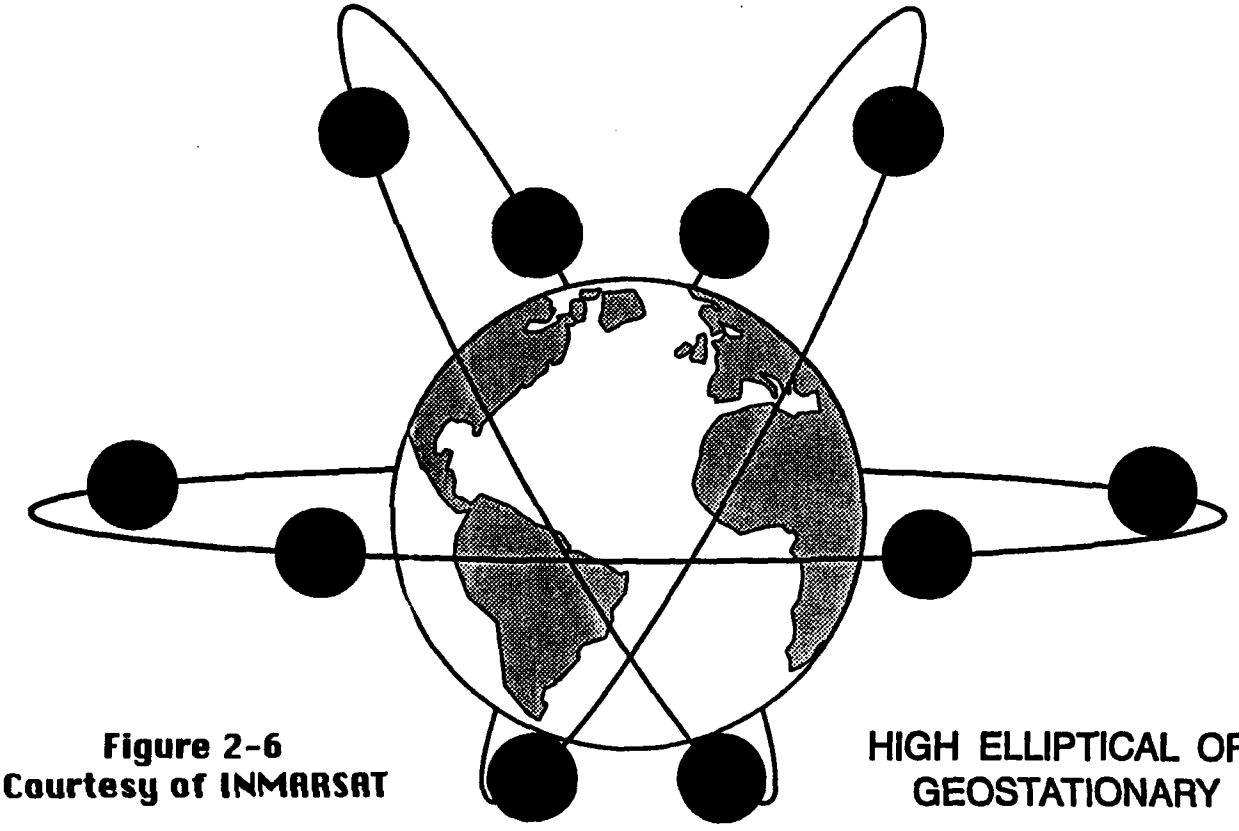


Figure 2-6
Courtesy of INMARSAT

HIGH ELLIPTICAL ORBIT &
GEOSTATIONARY ORBIT

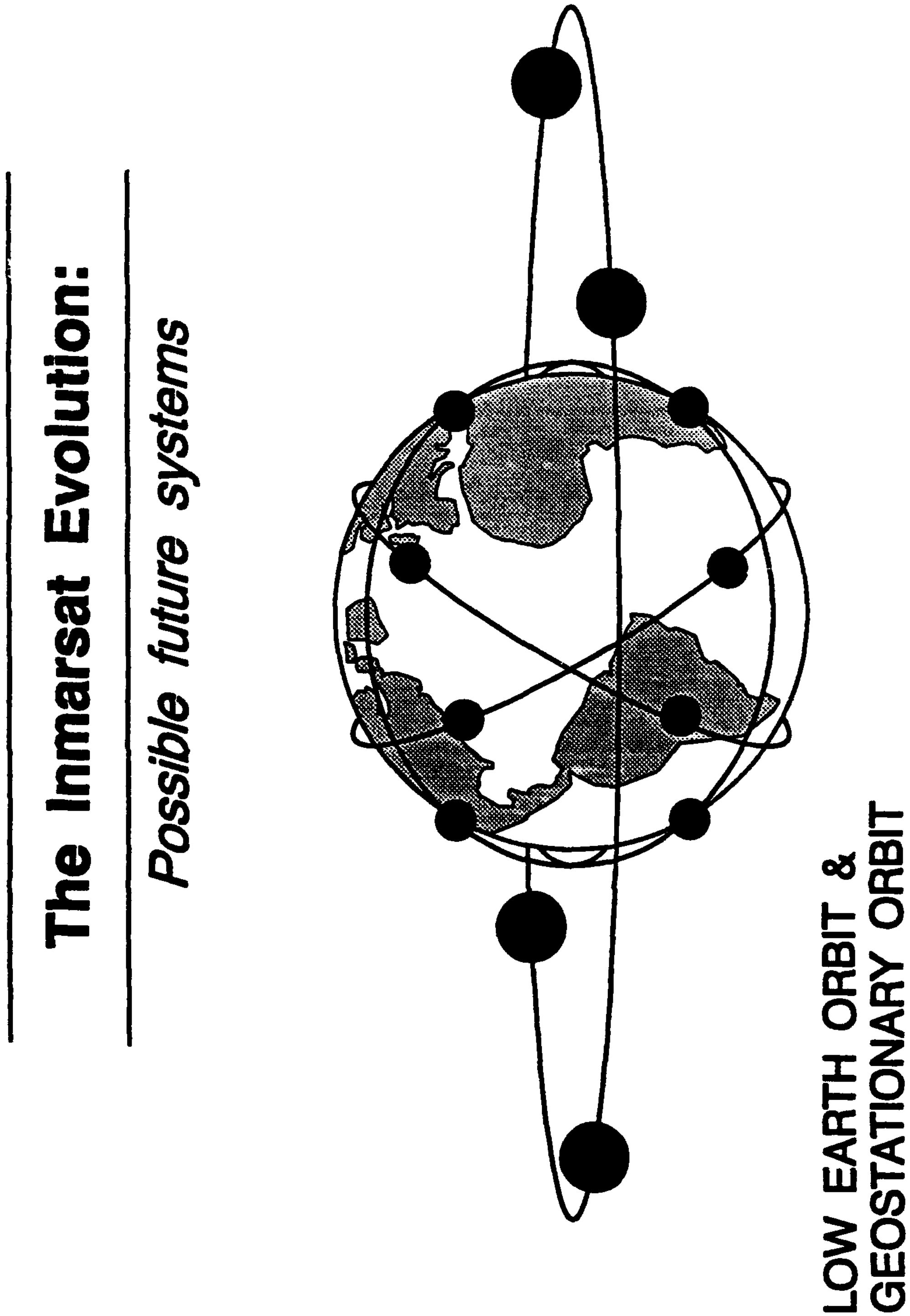


Figure 2-7
Courtesy of INMARSAT

So while Motorola attempts to recreate on land what is successfully operating on the seas today, the world's new

industries are also moving quickly to create successful land based markets with long-term contractual commitments in other countries. Today, INMARSAT is an internationally recognized global community made up of signatories, earth stations, national authorities, equipment manufacturers, and service providers[36].

SIGNATORIES

Each member Government nominates a sponsor or organization to be its INMARSAT Signatory. This body becomes its own financial shareholder in INMARSAT, participates in the decision making process, and usually provides its own services for its country. The 64 current members are composed of government departments, telecommunication authorities, ministry departments, and some private companies.

LAND EARTH STATION OPERATORS

These organizations own and operate their own land earth stations (LES) and provide the interconnection between the satellite and subscriber in the telecommunications network. It is important to point out that each LES operator establishes their own range of mobile services offered and establishes its own user charges.

National communication authorities

The communication services that originate from a fixed position (home or office) to mobiles are provided through the host countries' national telecommunications organizations who also set their own charges and fees. They also provide routing of calls through a convenient LES station.

Equipment manufacture

INMARSAT does not manufacture any equipment. But it does create the design requirements and establishes the proper standards for compatibility with satellite terminals. It also coordinates with industry leaders and regulators. Most of the manufacturers are part of the new European Community whose equipment is distributed and serviced through their worldwide network of dealers.

Value-added service providers

These varied and normally private companies offer enhanced service to the system and usually services such as management systems, data bases, options, etc.

INMARSAT Director General Olof Lundberg, is taking positive steps not only in maintaining current service with existing customers, but also in creating new relationships worldwide. Recently, Mr. Lundberg revealed his intentions to visit newly formed governments and offer his support in establishment of any long distance communication needs.

INTERNATIONAL EVENTS

"Delegates from the Civil Aviation Administration of China (CAAC) and INMARSAT expressed their mutual wish to cooperate on civil aviation"[37] and ordered Boeing to outfit their 747-200 jumbo jet for communication with the INMARSAT system. And because of the Pacific Rim's longtime communication potential, the INMARSAT Council has elected Richard Fong as its Chairman this year, replacing Saudi Arabia's Saad Demyati [38]. Fong is currently a vice president of mobile communications for the Ministry Department in Singapore.

Canada's International Civil Aviation Organization (ICAO) has identified Automatic Dependent Surveillance (ADS) as a required feature aboard all participating aircraft for global positioning by working with "the Air Traffic Control Via the INMARSAT satellite system"[39]. Global Positioning Systems (GPS) were developed for the US Air Force in the mid 1970s, but this counterpart for INMARSAT is being developed by GLONASS in the former Soviet Union [40].

The aviation industry is planning to exploit INMARSAT with high gain antennas on planes equipped with the CMA-2102 Airborne Satellite Communication Antenna. This antenna has been selected as optional equipment on the McDonnell Douglas MD-11 and offers "excellent performance with an economical design"[41].

The United States and the Commonwealth of Independent States have made agreements for private lines, public telephones, and mobile voice and data services in order to promote business development for energy industries. This allows Morsviazsputnik, a Russian State Company and signatory to INMARSAT, to purchase from IDB Communication Group a full range of mobile satellite communication services and products 42.

The British built CT2 telephone envision installation on Singapore Airlines that routes calls into an Airborne Telephone Cabin (ATCS) and places calls to a local earth station via satellite 43. This is significant because the phones conform to European agreed signaling standards called Common Air Interface (CAI).

NATIONAL EVENTS

The US signatory and one of the major investors in INMARSAT is the Communication Satellite Corporation (COMSAT) based in Maryland. COMSAT, along with Korea Telecom, have won a joint contract to expand the earth station's range in Kumsan and provide INMARSAT services in the Indian Ocean 44. Although agreements are uncertain, it appears Hyundai will provide the bulk of the resident equipment.

Advocates for allowing Russians to launch US made INMARSAT satellites are using Boris Yeltsin's Washington visit to prove their case. John Pike, Director of Space Policy for the

Federation of American Scientists said, "lifting the ban would provide tough new competition for emerging US launch industry, ...but [the] US has only 50% of the launch market and 80% of the satellite market. It's a choice of one or the other"[45].

Comsat Mobile Communications will begin testing for the FAA using a GPS INMARSAT geostationary system for navigation and would replace the conventional radar system [46]. The Satellite Navigation Program test is to determine if the new 10 meter accuracy is more reliable than ground radar's existing 100 meter accuracy [47].

Another very prominent US company breaking independent ranks and joint venturing is GTE Airfone of Oak Brook, Ill. It has joined with Northwest Airlines and COMSAT Aeronautical Services to utilize INMARSAT's ground earth station system in Southbury, Conn. and Santa Paula, California when access cannot be made to GTE's 109 ground stations. It should be noted that GTE Corporation is the fourth largest publicly owned telecommunications company in the world.

But there has not always been such a good relationship between INMARSAT, its manufacturers, and its subsidiaries. And how the issues were resolved by the participants is unique and interesting because it is a result brought about from necessity. To site an example, when INMARSAT users became concerned that rate reductions over the past several years were not keeping pace with other telecommunication phone companies, the disgruntled customers formed the

INMARSAT Users Association (IUA). One of the main goals of IUA is to push for lower rates and to increase the level of awareness of the consortium's customers needs. Some previous concerns have been the ease of system operation, electronic standards and pricing fairness. Although INMARSAT would prefer users to go directly through their appropriate signatories and resolve differences, the IUA points out messages get muddled when 64 members try to agree on bringing grievances to INMARSAT management to find resolutions [48].

ADDITIONAL USES

Recreational yacht owners are refitting these communication terminals onboard their vessels. "In 1991, a total of 833 yachts were fitted with INMARSAT standard-A type earth station. [Today], over 11,000 of the world's ships are now fitted with INMARSAT (A and C) satcom terminals"[49] and terminals are growing at a rate of 30 percent per year [50] said a UK designer of boats. And in the Whitebread 33,000 mile yacht race around the world, every boat was required to carry their C terminal to report positions to race headquarters on a regular schedule. Some were fitted with A terminal's for video transmission of interviews and action shots.

Even though many international and national companies are targeting the long haul trucking industry for low data

rate transmission business, INMARSAT has already installed its 20,000th satellite C terminal in an Iveco utility truck. The initial testing program will allow the driver to send and receive several pages of text and data with the home office in Turin, Italy. And to maintain its competitive advantage over the competition, INMARSAT is planning a major sponsorship of a telecommunication conference and exhibition show at the CNIT in La Defense, Paris from October 12-14, 1993 [51]. The goal is to bring worldwide recognition to mobile satellite communications and global positioning systems that affect regulators, users, manufacturers, and suppliers. Senior executives will speak about their personal perspectives and methods to use when coordinating with various agencies. One of the demonstrations of service customization that will probably be addressed at the conference is COMSAT's agreement with AT&T in July 1991. COMSAT Mobile Communication is the only INMARSAT partner to offer an interpretation service through AT&T's Language Line Service that will provide customers with on-line interpreter service 24 hours a day, 7 days a week for operator assistance of over 140 different languages.

To some, this service was originally thought of as more flash than substance. But when Southbury, Connecticut's LES received a Priority 3 alert (S. O. S.) distress call from a Soviet tanker, the service became invaluable. At 0055 GMT, the 28,259 ton Geri Chernomorjya collided with the 3,250 ton Siguida 17 miles off the island of Skiros, Greece. The radio

operators could only understand the words 'distress' 'fire' and 'collision', but without knowing the exact location delayed notifying the New York Coast Guard until the AT&T interpretation service came on-line in a three way call. At that time NYCG notified the proper rescue coordination center 52.

FINANCIAL SUPPORT

Despite strong customer support and a solid product position in the smallsat service industry, obtaining global sized financial backing is still no small undertaking. The capital outlays are phenomenally high, usually in the hundreds of million if not billions of dollars, and a three to five year wait before any profits are seen. For example, the first agreement entered into by INMARSAT was in 1988 to manufacture four of its second generation satellites. Now in April of 1992 the first three satellites are in operation and the fourth was recently launched this month from Kourou, French Guiana and will soon be operational 53. Coverage of the second generation's fourth satellite is from western Europe and west Africa to South America and the east coast of North America. The first three of the fourth generation satellites with a launch date of 1995 have recently been pre-leased for (UK pounds) 197 million. The European Investment Bank (EIB) and seven 'club' members of the European Long Term Credit Institutions (ISCLT) arranged the financing. The long standing

commitment of EIB and ISCLT to new high-tech Euro industries demonstrates an interest to preserve and improve the telecommunications in Europe, its infrastructure, and communication competitiveness of its institutions. The members involved in recent transactions are Germany, Italy, France, Denmark, Netherlands, Belgium, and Austria. In addition to spacecraft design, INMARSAT is increasing its number of global earth stations to a total of 27. One is located at Staten Island, N. Y. and will accommodate traffic from Europe, the western Commonwealth of Independent States, the Middle East, Africa, and Latin America. The second LES is located in Boumen, Iran to service Africa, Asia, and central Australia 54. Financial terms were not disclosed.

NICHE MARKETS

If small satellites are to enjoy much success at all they will have to revolve around personal communication services that have a single oriented mission. Dr. George Sebestyn, president of Defense Systems Inc., openly expresses his doubt that more than a few LEO communication systems will be successful, the greatest opportunity for success is INMARSAT. However, mission-specific applications such as oil exploration, medical applications, broadcasting, remote sensing, vehicle tracking, and the like promise to provide new opportunities for a very young industry, especially in launch services.

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Chapter III

LAUNCH VEHICLES

The discussion of satellite systems is always incomplete without a reference to orbital delivery systems. Governments are deeply interested in developing a parallel industry that is compatible with the international community of mobile communications. For this reason more subsidies are placed in development of launch systems than their communication systems. For one, the technology is transferable from a defense expenditure to a commercial revenue based industry. Second, the launch system usually is an extension of the civilian aviation industry that is heavily subsidized for trade and commerce reasons. With satellites becoming small 'Cray computers in a box' and operating at lower altitudes, more and more countries are capitalizing on the satellite industry as a way to enter the space industry with a subsidiary to offset expenses.

The policy makers, business climate, public attitudes, and perceptions greatly affect the US space industry. Many companies rely on the US government as a provider of space technology and research funding, a landlord for launch range sites and test locations, and as a partner in international

trade negotiations. Particularly with Intercontinental Ballistic Missile System negotiations and as a partner in loans, grants, capital, and insurer. This is derived from the high risk nature of space research that most companies cannot support themselves or collectively.

The Department of Transportation (DOT) regulates the space transportation industry with an Office of Commercial Space Transportation (OCST) as the primary representative agency. DOT and OCST provide licenses of commercial launches and are responsible for monitoring the public health and safety of launches 55. The three major U. S. vehicles today are General Dynamic's Atlas, McDonnell Douglas' Delta, and Martin Marietta's Titan. Most are modified versions that were previously built for Air Force and NASA projects. So when the United States is charged with unfair practices and protectionism by another foreign government, it is always difficult to identify what exactly constitutes an unfair subsidy. For example, areas such as underwriting medical or other space research, advanced testing of avionics, and experimental flight and control testing that is later transferred to commercial firms-gained through taxpayer support-are always disputed. Is building a launch site at US government's expense then providing it for commercial use unfair? Our interstate roadway system is very similar to the extent tax dollars build the network then used for interstate commerce of goods. The fact is that both the U. S. and other governments do provide these services to some degree or

another, the only way to ensure a level playing field is to guarantee that all countries are subsidizing the same areas equally, which is virtually impossible. Probably the most difficult comparison exists between products and services of various countries. "A payload owner considers the mix of launch service attributes- price, vehicle reliability, final payload placement accuracy, availability, insurance costs, scheduling flexibility, reflight policy, and impacts on satellite design and costs"[56].

Many countries are offering quality services that specialize in enough features to make this service unique to its users. Countries such as France, Japan, China, Russia, and others that plan to enter the launch market will need to discern fairly quickly their customer's needs. If not, other country's will be very willing to take its place as the service provider. If one were to put a satellite in orbit in the mid 1960s, NASA would coordinate with an Atlas or Delta, manufacturer to meet existing standards and launch around their schedules. Today there are a host of alternatives for both big and small satellites that are discussed below.

<u>Some services offered:</u>

The present world leader, Arianespace, controls about 60 percent of the commercial launch marketplace. Ironically, Arianespace is the result of a failure from Europa, a joint venture of French, British, and German technologies that never found much success. From 1982 until 1985, the US and

Ariane were "in stiff competition" [57] with each other. Both were greatly subsidized and made concessions to customers that some found unusual. But after the Challenger accident, "Arianespace became inundated with requests for open launch slots, or even standby reservations" [58]. As the demand curve increased the subsidy curve decreased driving up the price package for the launch of a medium size satellite from $18 to $50 million. For this reason ESA is conducting research on Ariane 5, a new vehicle that uses strap-on booster rockets. The presence of a launch site in French Guiana provides a distinctive advantage because it is very close to the equator and conducive for geostationary orbit satellites. "As of October 1991, Arianespace had a backlog of 33 satellites, worth a total of $2.4 billion in launch service revenues"[59].

Domestic Manufacturers

General Dynamic's Atlas engine was originally designed as an ICBM rocket and modified for civilian use. This restrains it somewhat because its propellant tanks must always be pressurized, three meter diameter complicates shipping and transportation, and the technology eventually became obsolete. Although it could be in a good position for success in the marketplace, it has the least amount of experience and has suffered some noteworthy setbacks in recent months. It was the first to obtain a Launch Operator's License from the DOT and the first NASA launch of a commercial carrier. But

three failures in the last ten launches have given some skeptics more reasons to look somewhere else due to reliability problems. But, surprisingly, maintains a backlog of 16 satellites for NASA and commercial use that are worth $850 million and is currently negotiating with the USAF for ten DSCS-III communication satellites [61].

McDonnell Douglas launched the first satellite built for United Kingdom British Satellite Broadcasting Service and for AT&T's Telstar 1 thirty years ago. It has a very respectable record of 205 launches with 193 successes and almost twelve launches in twelve months- some only a few weeks apart [60]. But the major limitation is lift capability of the Delta. The company would like to become more competitive with Atlas and Ariane but will not initiate a new rocket class unless it can land a large contract. "As of October 1991, McDonnell Douglas had a backlog of six commercial and NASA satellites worth about $300 million"[62]. Most of its long term business is with the Air Force's GPS system and Medium Launch Vehicles.

Martin Marietta's Titan is the only current U. S. launch vehicle which can put more than 22,000 pounds into a low earth orbit placing it against Arianespace as the global heavylifts. Marietta's outstanding commercial contract is with NASA for the Mars Observer worth over $153 million, but delays are possible because of funding restrictions and questions on the Transfer Orbit Stage which has not been fully

developed. It also has a military contract for 41 titan-IV launch vehicles worth $8 billion for the Air Force [63].

International Manufacturers

Japan's H-2 program followed similar strategies to enter the launch business as it did to enter the automobile business. First, the Japanese Space Agency NASDA, obtained a license to launch NASA's Delta launch vehicle. This avoided the development process, long learning curves, investment venture capitol, and related technologies to interface systems. Early vehicles were manufactured in America and assembled in Japan. As more and more launch vehicles were manufactured, there was an eventual replacement of certain key components of US made sub systems to Japanese made sub systems based on 15 years of working with Delta technology. Their problems are apparently more political than technical and NASDA has not yet marketed its H-2 to other countries. One possible reason is that the high latitude requires more fuel to maneuver to find the geostationary orbit. Other conflicts such as downrange fishing areas are congested with local fishermen in the prime trolling areas. To resolve this political problem, NASDA's agreements with fishermen are for only four months per year. However, its believed once H-2 becomes operational and profitable, Japan will offer it to the world as a litesat launch possibility on a permanent basis.

China and the former Soviet Union's representative country Russia, are also considering launch services. China's Great Wall Industry Corp. has successfully negotiated three launches of Western made satellites and Russia's Glavkosmos is currently looking for customers. However, current regulations qualify satellites as munitions and the US Customs have refused to authorize export licenses to send satellites to Russia. Soviets have said they would allow importation of satellites for launching and would not be inspected for sensitive components or technology, but have been ignored.

India's Augmented Satellite Launch Vehicle (ASLV-3) successfully launched a 106 Kg. satellite into a 450 Km. orbit on May 20, 1992. This is somewhat significant because ASLV was a codevelopment program with Russia's Prithvi surface-to-surface missile that uses cryogenic engine technology and violates the Missile Technology Control Regime. "This resulted in the U. S. suspending trade with both India and Russian space agencies for two years [64]."

The Australian government has asked its Industry Development Corporation to conduct a feasibility study on a privately funded spaceport in Cape York. The Australian government has recently set up the Australian Space Office (ASO) to coordinate related developments of its space projects and work with two consortiums of locally held companies. The ASO would determine the cost and feasibility

of the project after all studies are conducted. "First launches are scheduled to take place in 1993 or 1994 at a cost of about $ 550 million (US) and five launches per year are scheduled"[65].

Israel's Amos is taking large amounts of money from their military space program and reallocating it to their communications satellite, but plans to make modifications on both programs. Its reliance on US surveillance information for Iraqi troop movement and an early warning for Scud attacks frustrated Israel during the Gulf war. "Israel will test a camera aboard its third satellite, Offeq 3, to be launched ... aboard a Jericho Shavit booster"[66]. This would augment additional assimilated information through a geostationary satellite for enemy detection in an electronic battlefield environment.

In 1991, Argentina funded 9 million dollars to start up the National Commission for Space Activities (CONAE) and continued working on SAC-SB, an astronomical science project. It is being constructed by the Institute of Astronomy and Space Physics. Other immediate plans are for joint development projects with other Latin American countries.

The Brazilian Commission for Space Activities is one of two national space agencies. The other is the Instituto Nacional de Pesquisas Espaciais (INPE) and primarily concerned with research and joint ventures, such as with China, that will

establish International Satellite Communications (INSCOM) with China's associated space services. INSCOM is currently the goal for a Sino-Brazilian remote sensing satellite and will be launched in China if Brazil's launchpad is not completed. Alcantara Launch Center has recently been commissioned as Brazil's planned rocket launch site. The INPE works with atmospheric sciences, space sciences, and space engineering and related technologies and is concentrating its efforts to developing countries. Currently, it is suffering from budgetary constraints and unusually long delays.

Since 1962, Canada's been involved with space research activities and recently announced the Canadian Space Agency Act in December 1990. The plan is to establish a long term space plan for space research and scientific endeavors. "Its new budget increased to $ 357.4 million (US) for 1991-92, up from $ 285 million the previous year"[71]. The speed at which Canada is expanding into the space field is evident in this year's construction of its CSA's headquarters in Montreal and new recruiting efforts for astronauts to meet future needs.

LONG RANGE DOMESTIC PLANS

One of the projected goals of the US government's Strategic Defense Initiative is to develop a single stage-to-orbit (SSTO) launch vehicle with vertical takeoff and landing characteristics to be used as a space transport system. Called the Delta Clipper, developers are striving for short turnaround

times, low operational and maintenance costs, and a high level of reliability for both human and space cargo. And considering our historical relationship with aviation, continued heavy subsidies into the shuttle program are anticipated because of an aging and increasingly expensive system we have today. The SSTO is seen as an alternative to a high-launch-cost shuttle and the almost nonexistent National Aerospace Plane project. The Delta Clipper could fly either manned or unmanned from the White Sands Missile Range site in New Mexico. The vehicle "would carry 9000 Kg into a low earth orbit or 4500 Kg into polar orbit and stay there for seven days with in-orbit refueling to support missions to and from geostationary orbit and lunar bases" 72. Turnaround time is expected to be less than one week and the vehicle will be independent of traditional mission control and be compatible with commercial aviation when possible.

Although advanced composite material technology is feasible today, it has never been widly manufactured to support large scale prolonged requirements. System testing is another area which must be resolved prior to production. For example, the design of the scramjet engine's critical components which are required for Mach 6 to Mach 9 speeds needs to be evaluated. A special wind tunnel has recently been constructed at the California Institute of Technology to provide a 'good simulation' of speeds from M10 to M16. Meanwhile, Germany is researching a tunnel of greater sophistication and capabilities. Many believe the wall of M10-

15 does not warrant the additional expenses. "Federal Express would like to go back and forth to Germany from the US twice a day...but the earth simply isn't big enough to warrant aircraft that can cruise faster than M10-15"[73]. Not only is hypersonics exciting, but it may also be financially rewarding if satellite manufacturers subsidize the new airspaceplane and save on conventional launch services distributing a portion of the savings on to the traveling public during a routine international flight.

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Chapter IV

Methodology

History

Conjoint Analysis has been widely accepted as a popular procedure to measure customer's tradeoffs among many attributes of various products or services. "Since its beginnings in the early 1970s, there have evolved between 200 and 400 commercial applications of conjoint analysis [programs]" 67. Most of these commercial applications have been in product identification, pricing, segmentation, and product positioning when introducing new products to the marketplace. In short, it forces people to prioritize or tradeoff different attributes which are quantifiable responses. In this specific survey conjoint analysis was used to derive impartial questions as its primary goal and objective and then use the data in a software analysis program.

For example, consider the survey question regarding the purchase of an automobile:

Is the price of an automobile important?

Is fuel efficiency important?

IS the resale value after two years important?

Is the product manufacturer important?

The answer to all four questions may be yes, some of course more important than others-but making any discernible differences impossible to measure between the questions themselves. However, if the same type of question is phrased differently as demonstrated below, a difference in attributes can be determined:

Please distribute 100 points among the following characteristics you would consider before purchasing an automobile:

Price	.....points
Fuel efficiency	.....points
Resale after two years	.....points
Product manufacturer	.....points

total to 100 points

In the second case there would be a very noticeable difference among the respondents, because the manner in which the questions are asked forces a compromise between different attributes of an automobile purchase. This simple model can be extended to almost any application, and it has.

McKinsley and Company, a management consulting firm, has used conjoint analysis for results that are used in marketing and competitive planning strategy for their clients. Recently however, it has found a more diverse use. Conjoint studies were recently completed in a telecommunication's lawsuit regarding foreign importation (dumping) of their equipment. Other applications have been pharmaceutical

companies who claim profit loss by misleading competitive advertising and airline industries with its travel agent's reservation systems. Conjoint Analysis is being evaluated for its future applicability of more diffused industrial and administrative problems. For example, employee benefit package tradeoffs, salespersons' tradeoffs between commission income and leisure time, and predicting the outcomes of buyer-seller negotiations all have future applications.

Commercial Conjoint Analysis computer models have been extensively developed by a host of software suppliers. "One microcomputer package that has achieved considerable public and commercial application is Richard Johnson's Adaptive Conjoint Analysis"[68]. This system is somewhat unique because conjoint data is collected by a computer interactive system and customizes the respondent's answers. But Conjont's growing usage is mostly attributed to all of the microcomputer packages and performance characteristics of desktop computers and mini computers. This is because of the ease and simplicity of operation, not to mention the comparable costs of hiring a consultant.

During a normal conjoint analysis interview, respondents rank the levels of each attribute for performance. The 'best' and 'worse' quantifiable levels of each attribute are offered and asked , for example:

If two products were both acceptable in every other way, how important would THIS PARTICULAR DIFFERENCE be?

1 2 3 4

Least Important Most Important

Normally these values are assigned so that certain conditions or rules exist and may be rank in a particular order. Other conditions and parameters to consider to help in the final analysis phase are:

*Attributes are reflected so that large numbers will provide greater preferences or positive responses.

*Centered to have an average of zero, or a normal bell curve.

*Scaled to make the difference between the greatest-liked value and least-liked level equals an 'importance rating'.

Recently conjoint analysis has received a great deal of attention from many different institutions in the academics, industry, and governmental areas. Their use is to find applications among several different attributes for products and services that may be of practical value. Although much has been written about this analytical procedure, the major areas of consideration that seem to be of primary interest are:

* minimize prediction error.
* collecting data over telephone.
* reliability of measurements.

* validation.

* new applications and opportunities.

A study was conducted in the early 1980s and some of the results are as follows [69];

* Most conjoint studies pertain to consumer goods (59%), industrial goods (18%), financial services (9%), and mostly accounting (9%).

* Most of the applications are new product /concept evaluation, repositioning, competitive analysis, pricing, and market segmentation.

* Personal interviewing is the most popular data gathering procedure, but other methods such as survey's are also used.

It should also be noted that using six or fewer attributes is the most beneficial for a full profile curve. Placing too much information on the respondent at one time may cause confusion, information overload, or disinterest. "When faced with such tasks, respondents resort to simplifying tactics and the resulting part-worth estimates may distort their true preference's structures."[70]

But statistics are not able to consider realities of life. Factors such as politics, available frequency spectrum, technology developments, variable costs, and launch restrictions all contribute to uncertainties of products

relative to the competition. The three companies able to offer full service - Globalstar, Motorola, and INMARSAT - must still answer the following question: Do international business travelers representing large corporations need immediate access to voice, fax, and data information? All of the available literature distributed by the companies themselves go into great detail as to how, why, when, and where the international business traveler could use their particular service, but never site specific examples or industry groups.

In order to verify if the need is legitimate, a survey to various companies was investigated as a possible answer. There are generally three reasons to conduct a survey:

1. A standardized measurement allows honest interpretation of data from those polled.

2. Probability sampling is more scientific than rumors, meetings, or lobby efforts.

3. Collection of information about a specific question that is not available from any other source is the main reason for conducting a survey.

INTERVIEW

After conducting a small personal interview over the phone to several local companies, it was discovered most of them did not need and were not interested in portable mobile satellite terminals. The investigation was targeted to the Chief Information Officer of a local company and were asked a battery of eight standardized questions in a neutral

manner. Because of a seemingly small interest by the respondents, a mail out survey was created to provide more depth to compare domestic company's communication needs with this new technology being developed.

QUESTION DESIGN

A focus group of three individuals was first developed from professional engineers who are associated with the Telecommunications Department. The purpose and intent of the focus group was to review and rehearse the administration of the questionnaire regarding format, ease, and readability. General guidance and practical advice came from the School of Business in the Research Department that has extensive experience in survey applications. After several iterations were drafted and discussed, a final version was approved for distribution by the Thesis Chairman. All of the questions were self administered by the respondents themselves. The responses were limited to checking the space provided or circling the appropriate value as demonstrated in Annex IV. This intentional restriction was to keep the interpretation as easy as possible and to avoid potential ambiguous responses.

The main advantages of a self administered mail out survey are:

1. Low costs.
2. Minimal staff and facility requirements.
3. Good for a wide dispersion of the population.

4. Good for asking a battery of related questions.
5. Privacy and anonymous in their answers.

The disadvantages are:

1. Ineffectiveness of the mail system for cooperation.
2. Interviewer not present for help or clarification.
3. Careful questionnaire design is critical.
4. Only for closed questions with answers provided.
5. Respondents need good reading and writing skills.

SAMPLING

The top Fortune 1000 companies were divided into twenty-four industry codes (or groups) as defined by the U.S. Department of Commerce. Some of these groups consisted of over seventy-five companies where others had less than twenty companies per each group. From these twenty-four industry groups, five companies were randomly selected from each group as a representative sampling for a total population of 120 companies to be surveyed. See Annex I for a complete list of the surveyed companies. The random selection process was a result of wanting every company to have the same chance of being chosen, but restricted evenly across all of the potential twenty-four groups.

MAILING THE SURVEY

A self addressed stamped envelope and cover letter with instructions accompanied all the surveys that were mailed to

each of the companies. It provided instructions about completion and a brief description about mobile satellite telephone services. Each of the surveys were addressed to the attention of the Chief Information Officer.

All three methods - interviewing, question design, and sampling - constitute a total design survey process and are interrelated with each other. They each follow generally accepted methods of survey techniques and are accurate, credible, and the results can be replicated. But a much larger survey population that includes overseas based international companies would be recommended.

CODING

All of the twenty-eight respondents' answers were coded with a scheme that is identifiable to the computer. Each individual company was assigned its own identification number in the appropriate field column. The survey questions identified key words as attributes and noted their appropriate code response as indicated in Annex II. Each of the attributes was limited to a field length of eight characters so the use of acronyms was extensively used.After all the possible responses of each attribute were coded, the actual responses were recorded in the appropriate field of the program as shown in Annex III.

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CHAPTER V

ANALYSIS OF SURVEY

Surveys are an intricate part of any new marketable product that is intended to be sold on a large international scale to businesses, institutions, governments, and the public at large. Obviously the insight and knowledge gained from such a project is proprietary and closely guarded information, especially if the results of the survey might reveal certain technical advances that may provide a strategic advantage over its competitor.

The data created from the Conjoint Analysis questionnaire was used with the SPSS/PC applications software. Interpretative assistance came from the Institute of Behavioral Research Analysis Center at the University of Colorado at Boulder campus. Because of their extensive experience in large surveys with the Sociology and Psychology departments, their time was voluntary and their efforts greatly appreciated.

Although there are endless cycles and iterations that can be explored, only two were selected based on the amount of data available to answer the question - what are the primary concerns of a mobile satcom system to a potential user?

Mean frequency distributions of aggregate results were performed for all the questions in the survey. See Annex IV for a copy of the survey in which the participants responded to. Each survey was mailed to the attention of the Chief Information Officer of the company, because it is believed they would be in the best position to evaluate the future needs of their company.

Many of the graphs are self explanatory while others are discussed. The results of the survey with a mean frequency distribution bar graph are as follows:

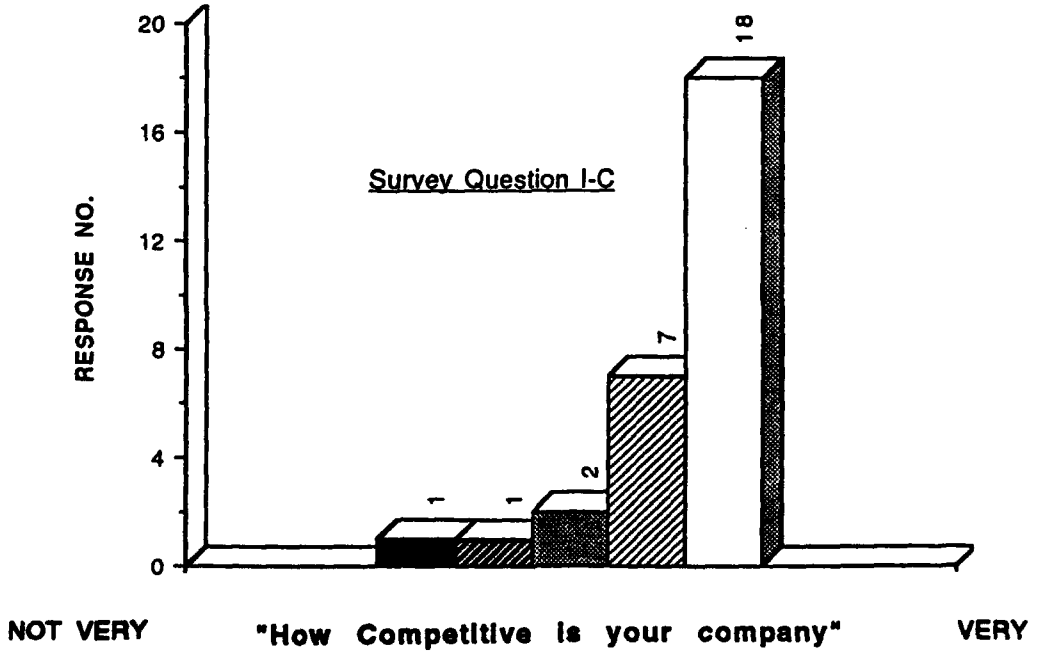
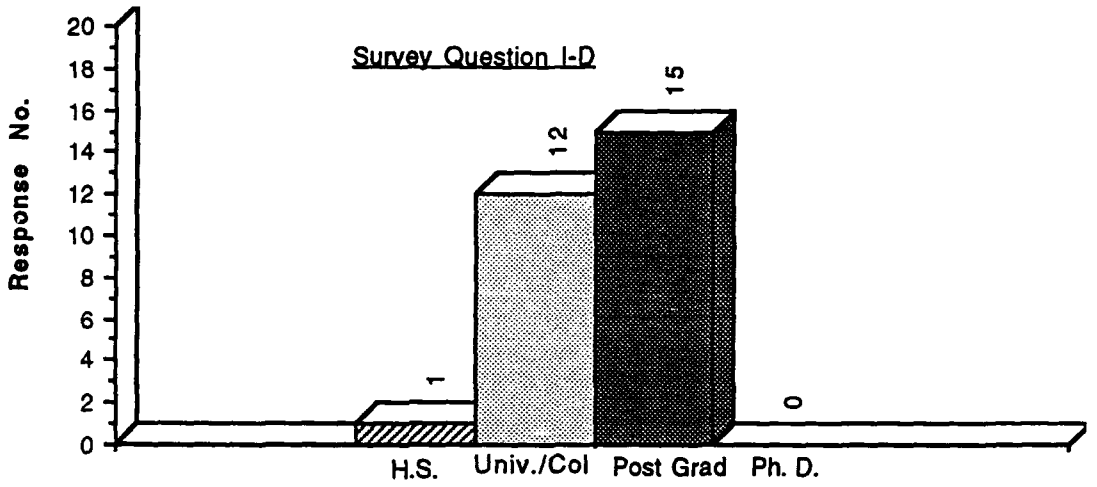
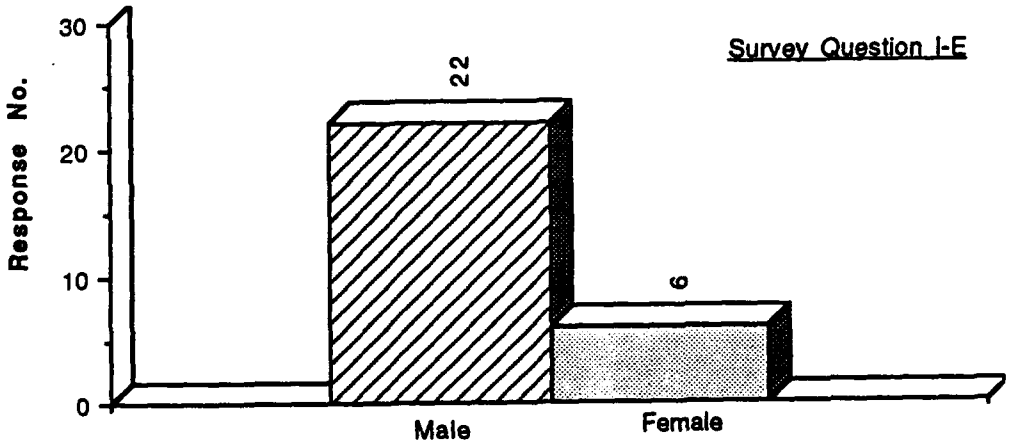


Figure 5-1



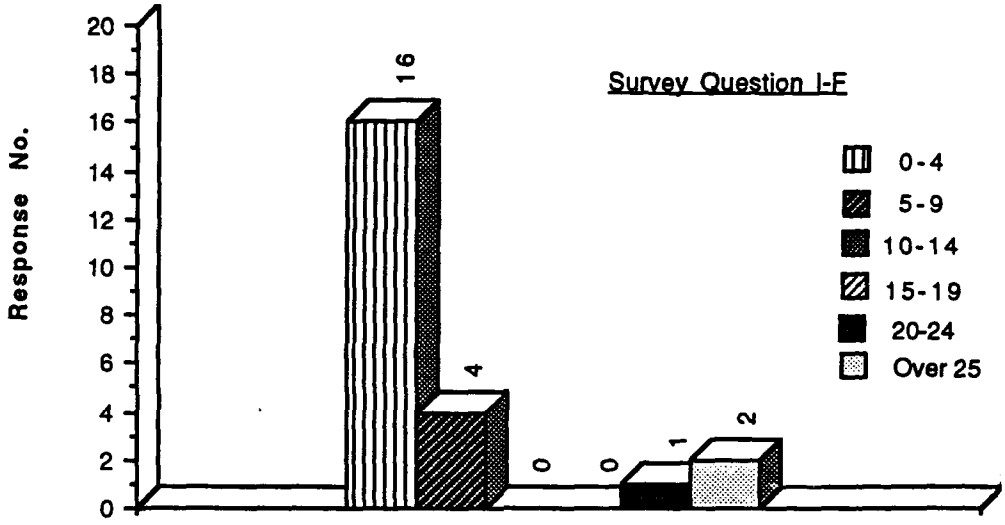
"HIGHEST LEVEL OF EDUCATION"

Figure 5-2



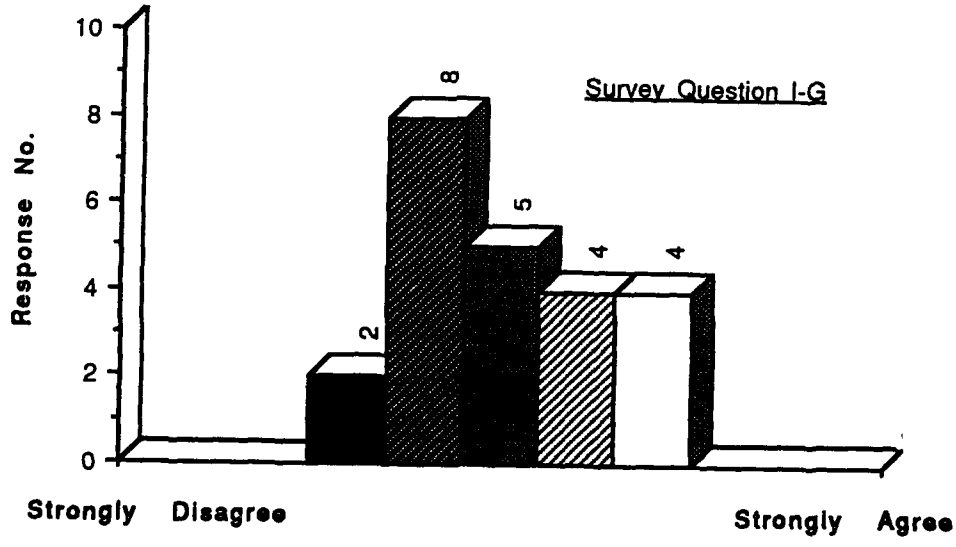
"WHAT IS YOUR GENDER"

Figure 5-3



"THE NUMBER OF TRIPS ABROAD PER YEAR"

Figure 5-4



"I HAVE BEEN SATISFIED WITH COMMUNICATION SYSTEMS ABROAD"

Figure 5-5

During the correlation process, a relationship was observed between the "bathtub" shape in Figure 5-4 and Figure 5-5. Those who frequently traveled abroad were more satisfied with existing communication systems overseas than those who traveled infrequently abroad and were generally dissatisfied with the service. One explanation may be the operational peculiarities of each country and not necessarily the quality of the circuit once call setup has been completed.

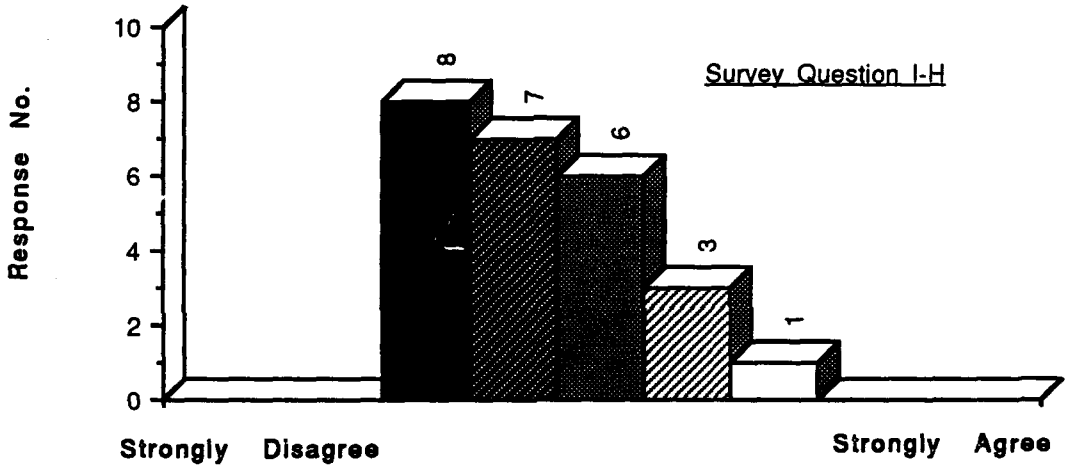
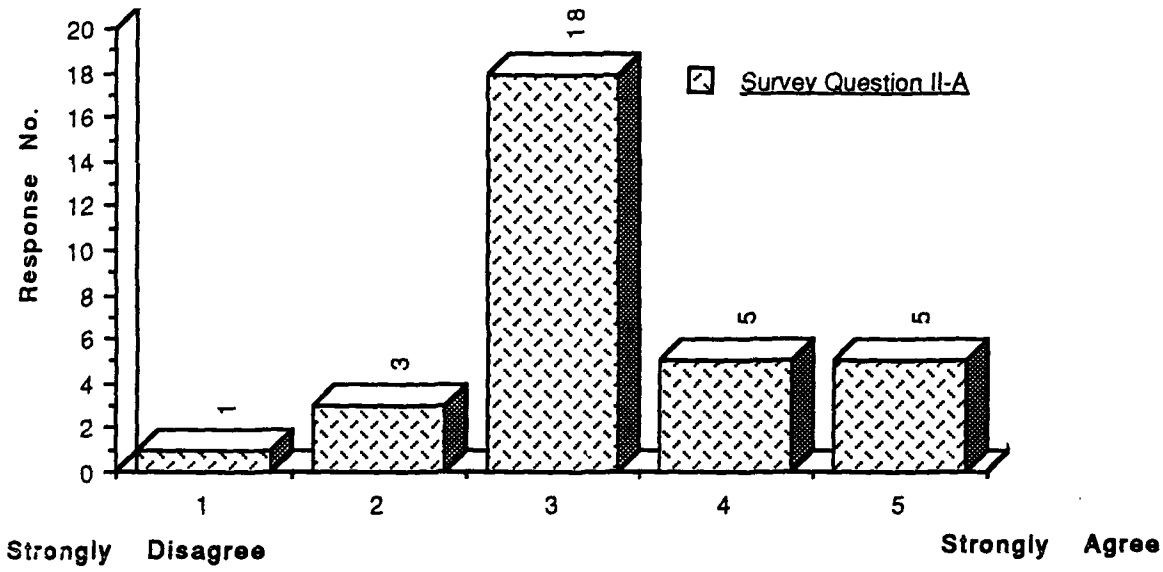


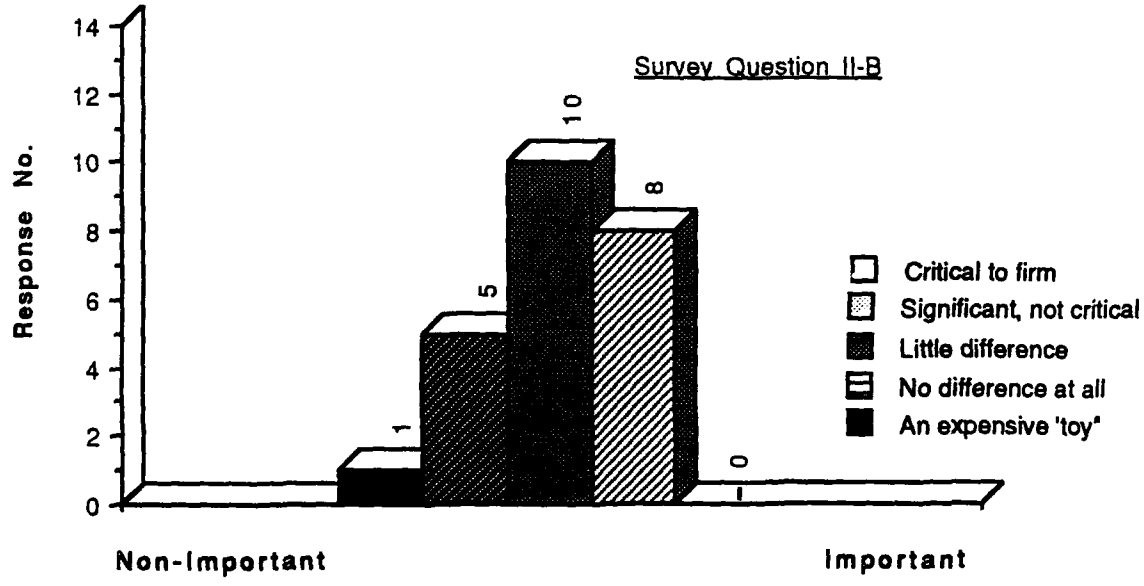
Figure 5-6

The objective of the question in Figure 5-6 above was to determine if the international business traveler was under any pressure or commitment to communicate while in route to their destination. It appears that most of the survey respondents have a great amount of control and flexibility in their professional schedule when traveling.



"A MOBILE SATELLITE PHONE WOULD MAKE MY WORK EASIER AND MORE EFFICIENT"

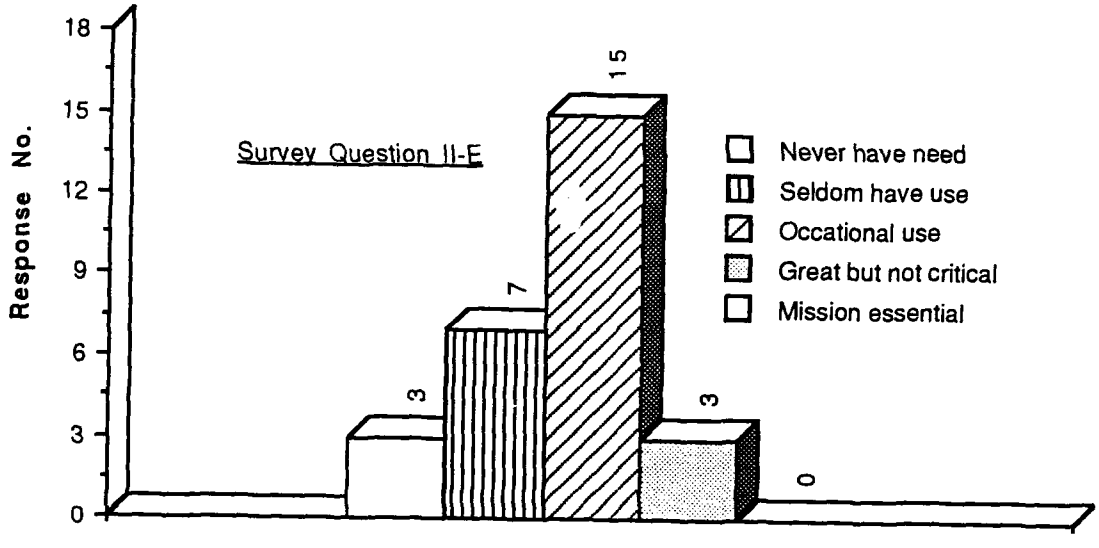
Figure 5-7



"SIGNIFICANCE OF MST TO ORGANIZATION'S EFFECTIVENESS"

Figure 5-8

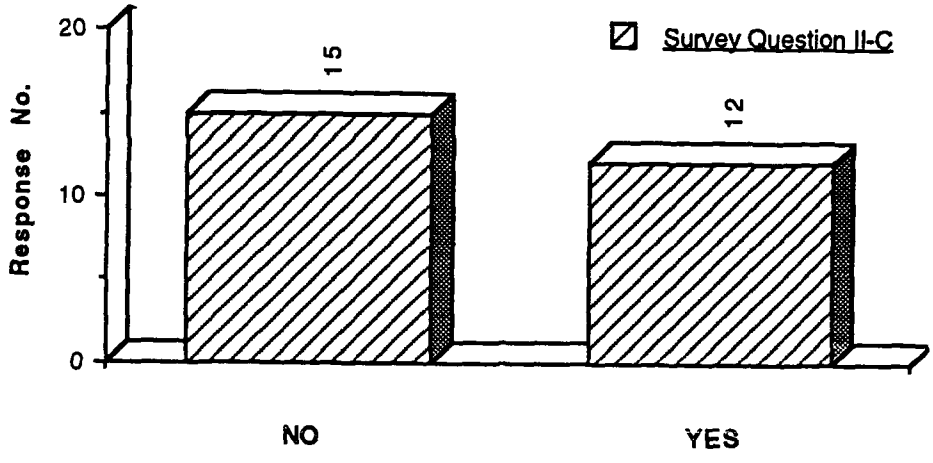
Figure 5-7 above reveals that respondents work would be easier if a MSS was available, however, it does not appear it would make a significant difference in their work related duties. Since most respondents believe the benefits derived from a MSS system are not very great, Figure 5-8 demonstrates even a smaller contribution that will be made to the organization's effectiveness.



"NEED FOR IMMEDIATE FAX, DATA, AND VOICE TRAFFIC WHEN TRAVELING ?"

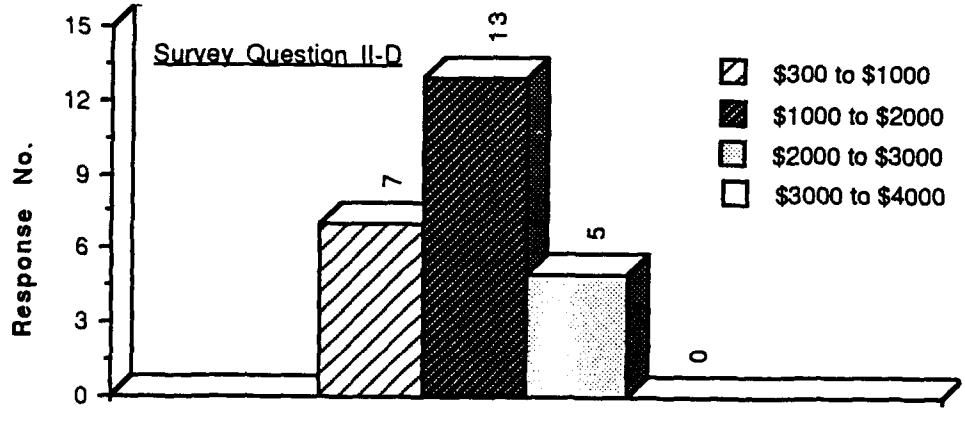
Figure 5-9

Figure 5-9 above reinforces an occasional need to communicate when traveling, with seldom use anticipated. Notice none of the respondents believed MSS to be mission essential to the effectiveness of the organization which is completely contradictory to published literature by the manufacturers.



"DO YOU OWN OR PLAN TO OWN A CELLULAR PHONE ?"

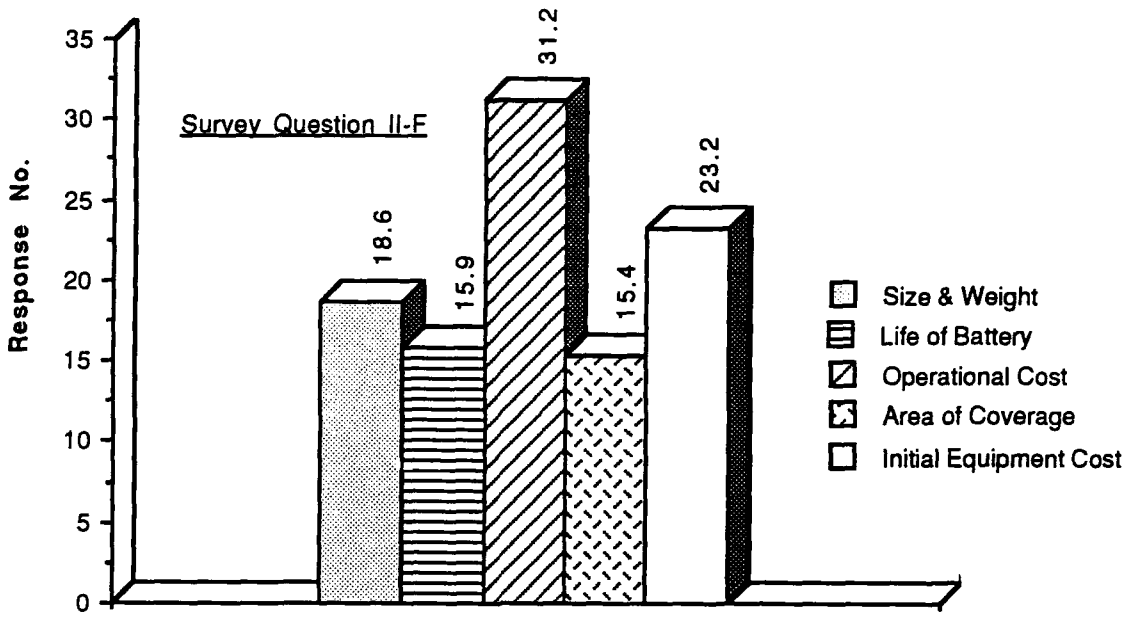
Figure 5-10



"INDICATE A 'REASONABLE' PRICE OF A MST"

Figure 5-11

Figure's 5-10 and 5-11 are self explanatory.



"AVERAGE MAJOR PURCHASING CONCERNS FOR A MST"

Figure 5-12

Figure 5-12 illustrates that operation and equipment costs are the most significant concerns when making a purchase decision. The least concern of most of the respondents was the area of coverage. This seems peculiar because it is fundamentally the reason for just such a purchase of this particular type of equipment.

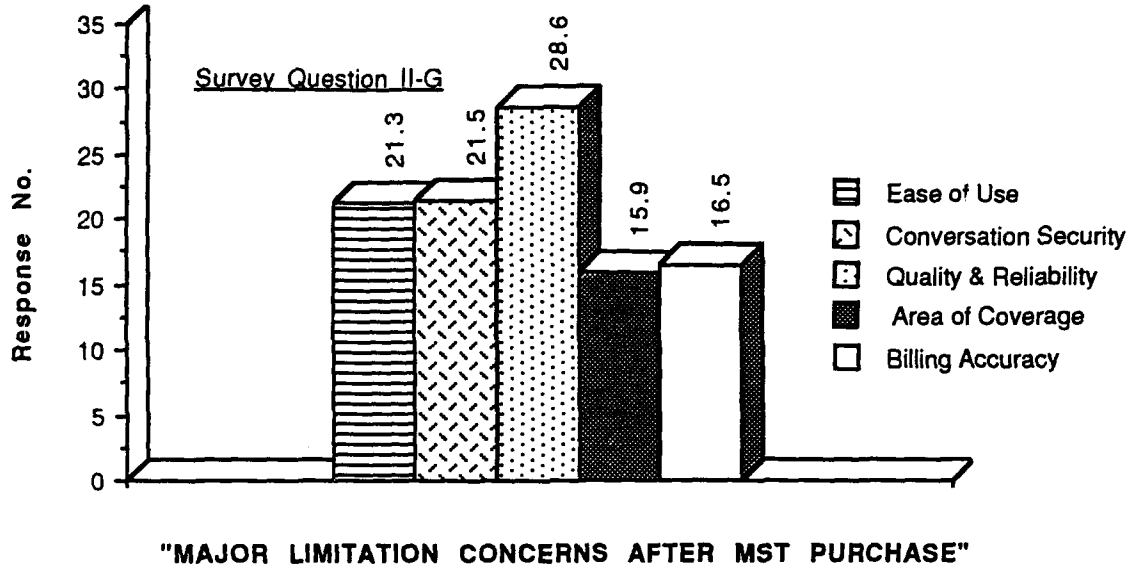


Figure 5-13

Figure 5-13 above shows quality and reliability as the greatest concern after a MSS purchase. Again, geographical area of coverage limitations came in last. Some possible explanations are that other quality communication systems would be available, its applications are not fully understood, or the need to communicate globally is not as great as the manufactures would like us to believe.

OTHER SIMILAR SURVEYS

Many other similar surveys have been conducted which were targeted to different corporate entities and at different levels of management. One such survey that follows for

comparison purposes is the IATA telecommunication survey among airlines.

IATA's survey was conducted for INMARSAT to airline managers and engineers by its Market and Economic Analysis Division. Its goal was to collect the opinions and attitudes of senior airline managers about on-board satellite communications systems for possible aircraft crew as well as passenger uses. By gathering information about benefits and concerns deemed to be important, it could identify policy choices for the future. One of the aims was not to provide a detailed statistical analysis of collected information, but rather to provide qualitative data on the current attitudes, prejudices, and trends in the industry.

METHODOLOGY

Thirty major airlines were contacted by IATA's Market and Economic Analysis Division. They were asked to select two members of the staff who could complete the questionnaire. Two groups were surveyed. One group would respond from the marketing & sales perspective while the other group would respond from the engineering & operational perspective of satcom radios. Out of seventeen airlines who responded, three were from the sales & marketing department and fourteen were from the engineering & operational departments. Personal interviews were conducted over telephone and fax networks from IATA's main office in UK from April to May 1991.

SUMMARY OF FINDINGS

The technology was viewed as a major step forward in avionics with most respondents expressing strong support for the technology. Both groups were concerned about their technological competitiveness with respect to other airline carriers. All showed concern about the high cost of initial installation for each aircraft, the uncertainty of return on investment, and the lack of equipment certification normally found in traditional avionics. An overall consensus is that although much has been accomplished with mobile satellite communications in aircraft, much work is still needed before turning the cockpit over entirely to a new technology. Out of thirty airlines surveyed, twelve said they are studying some type of satcom installation on a portion of their aircraft, four had no immediate plans at all, and one was unsure. A majority did view satcom as an eventual necessity in the distant future for improved navigation and wholesale passenger use. The major concerns of airlines to install satcom radios can be summed up by the following list:

* The cost of installation.
* Capital expenditure.
* Extra weight penalties and wind drag from antennas.
* Return on investment by increased passenger use.
* Resolving technical problems.

* Additional on ground maintenance costs.
* Certification.
* External market forces and the need to be competitive.
* Ease of operation and use by all aircraft members.

SIMILAR FINDINGS

The above survey, which was conducted by an independent agency for INMARSAT and which is much narrower in scope, illustrates similar concerns that involve the international business traveler. With a larger number of survey respondents and a higher percentage of survey returns, it will be demonstrated that conclusions from both surveys are very similar.

CHAPTER VI

CONCLUSION

General

Some broad assumptions may be deduced by analyzing the survey in the previous chapter and highlighting some important points.

For example, the expected benefits and savings of an MSS system can never be accurately determined, even though the actual user costs are. This unknown variable must somehow be considered to determine if the margin of savings warrants the total capital investments by a company.

Another issue to consider is the element of time. Technologies that were too expensive to fully implement in the past may become commonplace tomorrow. Facsimile machines fit very well in this profile. A decade ago facsimile machines were expensive and impractical. Today however, most businesses would consider them essential to their daily operation, even though a survey ten years earlier may not have demonstrated such a need.

Extending that example, the question become not if the consumer expects to use an MSS service - but when. Can a company such as Motorola - who is investing four billion

dollars - hold on until the marketplace catches up with the product? Since cost is the greatest factor for the respondents, one can assume the fee would be derived from the system which is the cheapest to build, launch, and operate. Where quality and reliability are the most important features of the system, geographical area of coverage is the least important feature. These facts should be of a major concern to MSS manufacturers because it appears to place the satellite system in direct competition with terrestrial systems which share the same qualities. This directly contradicts what manufacturers say is their intended objective, except in certain isolated circumstances pertaining to niche markets. Also, MSS operate on a 'line of sight' path to the satellites. That means handheld units must have an unobstructed view to the satellites which are positioned overhead. Thus, users must be outdoors and not encased inside steel metal buildings due to the low power levels and antenna gain limitations of the transceiver.

System Selection

As noted earlier, there are several companies competing for various parts of the mobile satellite market - but to varying and differing degrees. It appears that only three have the most comprehensive plan for global coverage of handheld units for individual mobile operation.

Considering all of the previous information, it would appear the systems most likely to succeed, in order, are Globalstar, INMARSAT's Project 21, and Motorola's Iridium.

Although Globalstar is not as well advertised as INMARSAT or Iridium, it promises to be the premiere, most efficient system currently being proposed today. On the basis of observations and conclusions from the previous chapter, cost and airtime appeared to be the primary concerns of potential consumers. This implies that the most efficient scheme which uses the limited spectrum for the greatest possible number of channels may gain an economy of scale advantage over their competitors. That, coupled with a simpler application of technology when available, will reduce the initial startup cost for system implementation.

Today, INMARSAT has a significant amount of experience in the maritime market with sophisticated long-standing political relationships with sixty-four member nations. With global economies and politics becoming ever more intertwined with each other, it is anticipated that a proprietary system such as Motorola's will be very difficult to sell internationally. Motorola also appears to be duplicating the existing and less expensive terrestrial systems currently in place and opting for a much more expensive and less reliable space based system. This becomes more of a factor with the arrival and ever increasing dependency on fiber optic cable for terrestrial systems. Especially when it comes to backbone networks and their redundancy requirements.

Globalstar appears to be employing the best of both worlds. Efficient terrestrial systems already in place and satellite technology for the system network user interface, using Satellite systems only to connect large areas of the earth's surface.

Because Globalstar uses a much higher orbit than Motorola, beam overlap occurs more frequently with significantly fewer number of satellites- 48. Iridium uses a smaller beam because of the application of an older time division multiple access technology that results in less spectrum efficiency.

TDMA does not allow for sharing of channels and frequency reuse in each cell site as does Code Division Multiple Access-CDMA, resulting in wasted opportunities. This demand based technology, when applied to cellular radios, can provide for as much as twenty to fifty times the number of users over conventional TDMA systems. In terms of mobile satellite communications, Iridium could handle 110 simultaneous voice calls over a 428 square mile area, whereas Globalstar could handle 2800 simultaneous duplex voice and data traffic within the same area. It should be noted that 428 square miles exceeds the boundary areas of cities such as New York, Paris, London, Boston, and Washington, DC.

By using a constellation of 48 satellites for continuous global coverage, each Globalstar satellite will operate only as a repeater in space. This puts most of the complex and

expensive circuitry on the ground rather than in space. This would eliminate complicated call-setup procedures and on-board processing occurring in a very harsh space environment where redundancy becomes expensive and necessary. Connecting the user network to a terrestrial gateway eliminates the need for inter-satellite cross links. This will be accomplished with each satellite using six spot beams for control of earth's surface coverage. These spot beam antennas are designed to compensate for delay differences in the satellite to user link with respect to the "near" and "far" problems encountered. This results in maintaining a constant power flux density to the satellite receiver transponder and an increase in the overall life of the circuitry.

The Globalstar ground segment consists of the following:

1. Gateway Station
2. The Network Control Center
3. Telemetry, Tracking, and Control

<u>The Gateway Station</u>

Each of the satellites communicates with the mobile users via the satellite user links and at the direction of the Gateway Stations' feeder links. Here, the Gateway Station coordinates the interface between the Globalstar satellite network and the Public switched telephone network (PSTN). Each Gateway station will be able to communicate directly with three satellites simultaneously to establish call setup

and processing. Several of these Gateway Stations currently being designed for operation in the U.S. alone. Most of these Stations will be connected directly to the mobile switch centers for the land mobile units. Overseas, it is expected each individual country will provide for its own individual Gateway Station and control user access. Since there are no limitations on the size or number of earth stations for each country, than it is conceivable that many Gateway's will overlap other users' boundaries and increase coverage efficiency.

NETWORK CONTROL CENTER

The NCC conducts the system functions of the global satellite network. Its functions include areas such as network database distribution, registration of users, verification, billing and call timing, and resource allocation apportionment (channels, bandwidth, message distribution, etc.).

TELEMETRY, TRACKING, AND CONTROL

The TT&C is part of the Constellation Control and Operation function and, among other things, monitors the "health" and orbit of each satellite. When appropriate, stationkeeping commands are transmitted to modify the orbit of the satellite from TT&C. TT&C also receive ranging and distance information from the satellite and uses this data for acquisition, synchronization, hand-off, and control of users calls.

Another unique advantage of Globalstar's use of CDMA is the hand-off characteristics from one satellite to another. In narrowband FDMA or TDMA that other systems are suggesting, a "break before make" procedure is employed. That is, the conversation is momentarily broken as the on-board satellite processors "look" for another available satellite channel. By contrast in Globalstar's CDMA design, an automatic "soft" hand-off occurs by the users handset or terminal. This can be of critical importance in data or fax transmission where the throughput may be diminished.

ANNEX I

COMPANY'S SURVEYED ADDRESSES BY INDUSTRY CODE

1. Aerospace

Boeing	7755 E. Marginal Way S.	Seattle, Wa.	98128
Grumman	1111 Stewart St.	Bethpage, N.Y.	11714
.Martin Marietta	6801 Rockledge Dr.	Bethesda, Md.	20817
Northrup	1840 Century Park E.	Los Angeles, Ca.	90067
Sequa	200 Park Ave.	New York, N.Y.	10166

2. Automotive

Chrysler	12000 Chrysler Dr.	Highland Park, Mi.	48288
Navistar Intl,	455 N. Cityfront Plaza Dr,	Santa Claria, Ca.	60611
Paccar	777 106th Ave NE.	Bellview, Wa.	98004
Ford Motor Co.	The American Rd.	Dearborn, Mi.	48121

3. Banks

Banc One	100 East Broad St.	Columbus, Oh.	43271
Boatmen's Banc.	800 Market St.	St. Louis, Mo.	63101
PNC Financial	Fifth Ave. at Wood ST	Pittsburgh, Pa.	15222
UJB Financial	301 Carnegie Center	Princeton, NJ	08543
Suntrust Banks	25 Park Place NE.	Atlanta, Ga.	30303

4. Chemicals

Betz Laboratories	4636 Somerton Rd.	Trevose, Pa.	19053
Great Lakes Chemical	P O Box 2200	West Lafayette, In.	47906
Lubrizol	29400 Lakeland, Blvd.	Wickliffe, Oh.	44092
Rohm & Haas	Ind Mall West	Philadelphia, Pa.	19105
Witcc	520 Madison Ave.	New York, NY.	10022

5. Conglomerates

Household Intl.	2700 Saunders Rd.	Prospect Heights, Il.	60070
Itel	Two North Riverside Plaza	Chicago Il.	60606
Ogden	Two Pennsylvania Plaza	New York, NY.	10121
Pall	2200 Northern Blvd.	East Hills, NY.	11548
Valhi	5430 LBJ Fwy.	Dallas, Tx.	75240

ANNEX I (CONT)

6. Consumer Products

American Brands	1700 E. Putnam	Old Greenwich, Ct.	06870
Clorox	1221 Broadway	Oakland, Ca.	94612
Coca-Cola	One Coca-Cola Plaza NW	Atlanta, Ga.	30313
Coors (Adolph)	311 10th St.	Golden, Co.	80401
Maytag	403 W Fourth St.	Newton, Ia.	50208

7. Containers/Packaging

Ball	345 South High St.	Muncie, In.	47305
Crown Cork & Seal	9300 Ashton Rd.	Philadelphia, Pa.	19136
Federal Paper Board	75 Chestnut Ridge Rd.	Montvale, NJ.	07645
Longview Fibre	Fibre Way	Longview, Wa.	98632
St. Joe Paper	1650 Prudential Dr.	Jacksonville, Fl.	32207
Sonoco Products	One N. Second St.	Hartsville, NC.	29550

8. Discount/Fashon Retailing

Dayton Hudson	777 Nicolette Mall	Minneapolis, Mn.	55402
Duty Free Intl.	19 Catoonah St.	Ridgefield, Ct.	06877
Family Dollar Stores	10401 Monroe Rd.	Matthews, NC.	28105
May Dept. Stores	611 Olive St.	St. Louis, Mo.	63101
U. S. Shoe	One Eastwood Dr.	Cincinnati, Oh.	45227

9. Electrical/Electronics

Cypress Semiconductors	3901 N. First St.	San Jose, Ca.	95134
Emerson Electric	8000 W. Florissant Ave.	St. Louis, Mo	63136
Hubbell	584 Derby-Milford Rd.	Orange, Ct.	06477
Nat'l Semi'or	2900 Semiconductor Dr.	Santa Clara, Ca.	98051
Square D	1415 South Roselle Rd.	Palatine, Il.	60067

10. Food

Albertsons	250 East Parkcenter Blvd.	Boise, Id.	83726
American Stores	709 E. South Temple	Salt Lake City, Ut.	84102
CPC Intl.	700 Sylvian Ave.	Englewood Cliffs, NJ.	07632
Heinz (H. J.)	600 Grant St.	Pittsburgh, Pa.	15219
Kellogg	One Kellogg Square	Battle Creek, Mi.	49016

ANNEX I (CONT)

11. Fuel

Enron Oil & Gas	1400 Smith St.	Houston, Tx.	77002
Enterra	2707 North Loop West	Houston, Tx.	77008
Halliburton	500 North Akard St.	Dallas, Tx.	75201
Sun	100 Matsonford Rd.	Randor, Pa.	19087
Tosco	2300 Clayton Rd.	Concord, Ca.	94520

12. Health Care

Abbott Labs	One Abbott Park Rd.	Abbott Park, Il.	60064
Acuson	1220 Charleston Rd.	Mountainview, Ca.	94043
U. S. Healthcare	980 Jolly Rd.	Blue Bell, Pa.	19422
United Healthcare	9900 Bren Rd. East	Minnetonka, Mn.	55343
Xoma	2910 Seventh St.	Berkley, Ca.	94710

13. Housing

CRI Liquidating	11200 Pockville Pike	Rockville, Md.	20852
Holnam	6211 North Ann Arbor Rd.	Dundee, Mi.	48131
Kaufman & Broad	10877 Wilshire Blvd.	Los Angeles, Ca.	90024
New Plan Realty	1120 Ave of Americas	NY,NY.	10036
RPM	2628 Akron Rd.	Wooster, Oh.	44252

14. Leisure Time Products

Cracker Barrell	Hartman Dr.	Lebanon, Tn.	37088
Gibson Greetings	2100 Section Rd.	Cincinnati, Oh.	45237
Polaroid	549 Technology Square	Cambridge, Ma.	02139
Shoneys	1727 Elm Hill Pike	Nashville, Tn.	37210
United Artists	2930 East Third Ave.	Denver,Co.	80206

15. Manufacturing

Avery Dennison	150 N. Orange Grove Blvd.	Pasadena,Ca.	91103
Danaher	1250 24th St. NW.	Washington, DC.	20037
Kennametal	RT 981 at Westmoreland	Latrobe, Pa.	15650
Teleflex	630 W. Germantown	Plymouth Mtg, Pa.	19462
West Point-Pepperell	233 South Wacker Dr.	Chicago, Il.	60606

ANNEX I (CONT)

16. Metal and Mining

Battle Mountain	333 Clay St.	Houston, Tx.	77001
Nucor	4425 Randolph Rd.	Charlotte, NC.	28211
Oregon Steel	14400 N. Rivergate Blvd.	Portland, Or.	97203
Phelps Dodge	2600 N. Central Ave.	Phoenix, Az.	85004
Precision Castparts	4600 SE Harney Dr.	Portland, Or.	97206

17. Nonbank Financial Services

American Express	Am Exp Twr World Finl Ctr	NY, NY.	10285
Home Beneficial	3901 West Broad St.	Richmond, Va.	23230
St. Paul	385 Washington St.	St. Paul, Mn.	55102
Transamerica	600 Montgomery St.	San Francisco, Ca.	94111
USF&G	100 Light St.	Baltimore, Md.	21202

18. Office Equipment and Service

Hewlett-Packard	3000 Handover St.	Palto Alto, Ca.	94304
NCR Corporation	1700 S. Patterson Blvd.	Dayton, Oh.	45479
Seagate Technology	920 Disc Dr.	Scotts Valley, Ca.	95067
Symbol Tech.	116 Wilbur Place	Bohemia, NY.	11716
Synoptics Comns.	4401 GrAmerica Pkwy	Santa Clara, Ca.	95052

19. Paper and Forest

Champion Intl.	One Champion Plaza	Stamford, Ct.	06921
Glatefelter	228 S. Main ST.	Spring Grove, Pa.	17362
James River	120 Tredegar St.	Richmond, Va.	23219
Kimberly-Clark	World Headquarters	Dallas, Tx.	75261
Weyerhaeuser	33663 Weyerhaeuser S.	Federal Way, Wa.	98003

20. Publishing

CBS	51 West 52nd St.	New York, NY.	10019
Century Communs.	50 Locust Ave.	New Canaan, Ct.	06840
Readers Digest	Readers Digest Rd.	Pleasantville, NY.	10570
Topps	254 36th St.	Brooklyn, NY.	11232
Tribune	435 N. Michigan Ave.	Chicago, Il.	60611

ANNEX I (CONT)

21. Service Industries

Browing-Ferris	757 N. Eldridge	Houston, Tx.	77079
Calgon Carbon	500 Carbon Dr.	Robinson Twp., Pa.	15205
Cintas	6800 Cintas Blvd.	Cincinnati, Oh.	45262
Jacobs Engineering	251 S. Lake Ave.	Pasidena, Ca.	91101
Zurn Industries	One Zurn Place	Erie, Pa.	16514

22. Telecommunications

Ameritech	30 S. Wacker Dr.	Chicago, Il.	60606
Associated Comms	200 Gateway Towers	Pittsburgh, Pa.	15222
MCI Comms.	1133 19 St. NW	Washington, DC.	20036
Rochester Telephone	180 S. Clinton Ave.	Rochester, NY.	14646
Scientific-Atlanta	One Technology Pkwy.	Norcross, Ga.	30092

23. Transportation

American President	1111 Broadway	Oakland, Ca.	94607
Florida East Coast	1650 Prudential Dr.	Jacksonville, Fl.	32207
Roadway Services	1077 Gorge Blvd.	Akron, Oh.	44309
Southwest Airlines	2702 Love Field Dr.	Dallas, Tx.	75235
Union Pacific	Eighth and Eaton Aves.	Bethlehem, Pa.	18018

24. Utilities and Power

Central & SW.	1616 Woodall Rodgers Fwy	Dallas,Tx.	75202
Central Hudson G&E	284 S. Ave.	Poughkeepsie, NY.	12601
Pennsylvania Pwr.	Two North Ninth St.	Allentown, Pa.	18101
Scecorp	2244 Walnut Grove Ave.	Rosemead, Ca.	91770

All addresses courtesy of Business Week, April 15, 1991, Business week 1000

ANNEX II

CODING SCHEME

SURVEY QUESTION	CODEWORD	COMPUTER CODES
1A	INDUSTGP	1=Real Estate
		2=Forest products
		3=Industry
		4=Chemicals
		5=Electronics
		6=Manufacturing
		7=Financial
		8=Computer
		9=food & drug
		10=Utility Companies
		11=Automotive Transport
		12=Packaging
		13=Insurance
		14=Media
		15=Real Estate
1B	FUNCTION	1=Executive Management
		2=Research Development
		3=Consultant
		4=Marketing
		5=Finance
		6=Human Resource
		7=Sales
		8=Engineering
		9=Other
		-9=Missing Data

ANNEX (CONT)

QUESTION	CODEWORD	COMPUTER CODE
1C	COMPETIT	1=Not Competeitive 2=Little Competitive 3=Moderately Competitive 4=Mostly Competitive 5=Very Competitive
1D	EDUCLEVL	1=High School Graduate 2=College/University Graduate 3=Post Graduate 4=Ph.D. Graduate
1E	GENDER	1=Male 2=Female
1F	BUSTRIP	1=0 TO 4 2=5 TO 9 3=10 TO 14 4=15 TO 19 5=20 TO 24 6=25 AND MORE -9=Missing Data
1G	SATLVABD	1=Strongly Disagree 2=Mildly Disagree 3=Neutral 4=Mildly Agree 5=Strongly Agree -9=Missing Data

QUESTION	CODEWORD	COMPUTER CODE
1H	PREFEVAL	1=Strongly Disagree 2=Mildly Disagree 3=Neutral 4=Mildly Agree 5=Strongly Agree
11A	WRKESEFF	1=Strongly Disagree 2=Mildly Disagree 3=Neutral 4=Mildly Agree 5=Strongly Agree
11B	SIGNEFFC	1=Survival of Company 2=Significant 3=Little Difference 4=No Difference 5=Expensive "TOY" -9=Missing Data
11C	CELLPHON	1=NO 2=Yes
11D	PRICE	1=$1,000 to $2,000 2=$2,000 to $3,000 3=$3,000 to $4,000 4=Other
11E	COMMNEED	1=Very Great Need 2=Great, But Not Critical 3=Occational Need 4=Seldom, If Ever Need 5=Never Need

ANNEX (CONT)

THE COMPUTER CODE IS THE ACTUAL RESPONDENT'S VALUES PROVIDED ON THE SURVEY FOR THE FOLLOWING QUESTIONS;

QUESTION	CODEWORD
IIF	SIZEWGT
IIF	BATTLIFE
IIF	OPNSCOST
IIF	AREACOVR
IIF	INSTCOST
IIG	USEEASE
IIG	SECURITY
IIG	QUALLIMT
IIG	HOLEAREA
IIG	ACTGACCU

ANNEX III

THE FIELD CODES

CODEWORD VARIABLE	FIELD COLUMNS
COID	1-3
INDUSTGP	4-5
FUNCTION	6-7
COMPETIT	8-9
EDLEVL	10-11
GENDER	12-13
BUSTRIP	14-15
SATLVABD	16-17
PERFEVAL	18-19
WRKESEFF	20-21
SIGNEFF	22-23
SPACE	24
CELLPHON	25-26
PRICE	27-28
COMMNEED	29-30
SIZEWGT	31-33
BATTLIFE	34-36
OPNSCOST	37-39
AREACOVR	40-42
INSTCOST	43-45
USEEASE	46-48
SECURITY	49-51
QUALLIMT	52-54
HOLEAREA	55-57
ACCTACCU	58-60

ANNEX IU

SAMPLE OF COUER LETTER AND SURUEY

University of Colorado at Boulder

Interdisciplinary Telecommunications Program

Dear ladies or Sir's,

I am a graduate student in Telecommunications Management at the University of Colorado in Boulder, Colorado. As you are probably aware, the technological explosion today in information systems have enabled certain manufacturers of communication's equipment to economically launch, to a varying degree, a constellation of satellites that will allow total mobility of the user. That is, someone in Canada may communicate with someone in Africa at any desired time- sort of a cellular phone concept where the world is one big cell site. Your response to the attached survey will allow us to evaluate and analyze the various systems being proposed so that a determination may be made as to the most probable system for success.

To ensure accuracy of our results your response is vital. Because our budget is very limited, only a small number of companies have been contacted. Your help and assistance in filling out this survey should take approximately 15 minutes and is important to the overall success of the project.

As with all research conducted through the University of Colorado, all responses will be kept strictly confidential, your participation is voluntary, and you have the right to refuse to answer any question for any reason. Only aggregate results will be reported in any publication.

Should you have any questions, please contact my faculty advisor or myself at the address's below.

Should you desire, a summary of results will be made available to all interested respondents by checking the appropriate blank inside the survey.

Thank you very much in advance and we hope to be hearing from you soon!

Sincerely,

Eric M. Hainzer

Eric M Hainzer
Principal Investigator
790 Krameria St.
Denver, Co. 80220
(303) 399-4329

University of Colorado at Boulder
Engineering Center, EE 2-21A
Campus Box 530
Boulder, Colorado 80309
(303) 492-3013/8916
Professor Stanley E. Bush

University of Colorado at Boulder

Interdisciplinary Telecommunications Program

SURVEY OF POTENTIAL MOBILE SATELLITE COMMUNICATION USERS

* *Please fill in the blank and comment as required.*
* *It should take about 15 minutes to complete.*
* *"Firm" may also mean division, section, etc.*

Eric Hainzer / M.S. in Telecommunications Management
University of Colorado at Boulder
Boulder, Co. 80309

SECTION I. GENERAL

A. Indicate in which major industry group your firm is engaged in. (Real Estate, Forest Products, Industry, etc.)_____

B. What area describes your functional area of responsibility?

_____Executive Management _____Marketing _____Sale

_____Research/Development _____Finance _____Engineer

_____Consultant _____Human Resource _____Other

C. From a strategic perspective, how successful do you believe your company is against it's nearest competitor?

Not competitive at all 1 2 3 4 5 Very Competitive

D. Please indicate your highest level of education.

_____High School Graduate _____PostGraduate

_____College/University Graduate _____PHd

E. Please Indicate your gender

_____Male _____Female

F. Please indicate the number of overnight business trips you take in one year for professional reasons outside of the United States.

_____0 to 4 _____5 to 9 _____10 to 14

_____15 to 1 _____20 to 24 _____25 to 30

G. In the past when traveling abroad, I have been generally satisfied with the existing communication systems that were available to me.

Strongly disagree 1 2 3 4 5 Strongly Agree

H. When traveling, my annual performance evaluation is proportional to how well and how fast I can communicate back to my "home" office.

Strongly Disagree 1 2 3 4 5 Strongly Agree

SECTION II. TECHNICAL

A. If I have a mobile satellite telephone and I can talk or send to anyone at any time, it would make my work easier and more efficient when traveling.

Strongly Disagree 1 2 3 4 5 Strongly Agree

B. Today, if your company has a mobile satellite telephone system, how significant do you think it would be to the overall effectiveness of the organization?

_____The difference would be survival of my company.
_____A significant but not critical difference.
_____Little if any difference in effectiveness.
_____No difference at all in effectiveness.
_____An expensive "toy" and potential hinderance to effectiveness.

C. Do you have or plan to have a cellular carphone?

_____No _____Yes

D. Please indicate what a "reasonable" price would be for a cordless telephone system capable of communicating anywhere by satellite.

_____$1,000 to $2,000 _____$2,000 to $3,000

_____$3,000 to $4,000 _____Other($_____)

E. When traveling, how would you classify your need for worldwide immediate mobile satellite communications for voice, data, or fax (ie on a boat, plane, car, in a building)?

_____Very great need; mission essential.
_____Great need, but not critical.
_____Occasional need, nice to have.
_____I would seldom if ever need one.
_____I would never need to use such a phone.

F. Please distribute 100 points across five major areas of concern if you or your firm were to purchase a mobile satellite phone today.

Physical size and weight of phone. _____pts.
Battery life before recharge/replacement. _____pts.
Operational costs (ie airtime, maintenance...). _____pts.
Area of coverage (not just US/Europe; Asia/N.Pole). _____pts.
Initial equipment system costs. _____pts.

G. After purchasing a mobile satellite phone system, you discover some limitations. Please distribute 100 points across these limitation categories.

Ease of use and operation. _____pts.
Security of conversation, data, or fax. _____pts.
Quality/reliability limitations (Noise, resolution) _____pts.
Coverage limitations ("holes" in some areas). _____pts.
Accurate billing and accounting statements. _____pts.